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EDITORIAL NOTES.

Street and Shop Lighting in War Time.

THE airship as an effective instrument in warfare has made its *début* with startling vigour in the present war. It is a development of which good use is being made not only for reconnoitring purposes but for the aërial invasion of cities and towns, and making things lively and uncomfortable for the residents. For this latter purpose, the ships steal forth in the night; but experience at Antwerp informs us that the aërial bomb-throwers did much less damage when the street and shop lights were extinguished or else obscured than they were successful in accomplishing before. The case for an effective nocturnal effacement of the features of London and of littoral towns east and south is complete. But unfortunately there is as much obscurity about the local instructions to give effect to the regulations as there is about the achieved result. Almost everywhere a decided crudeness and indefiniteness are to be found in regard to the manner in which the regulations are being carried out; and in London there is great want of uniformity between the different areas. Of course, different areas, varied lighting and importance; and it may be taken for granted that the objectives of the "men at the helms" of any invading Zeppelins would be the buildings of most value, in order to effect the maximum damage to produce the maximum consternation among the civilian population. All the same, there is much divergence of instruction and method in giving effect to the regulations; and the members of the Illuminating Engineering Society are conscious that, if only the powers that be in this matter would take them into consultation, public lighting and shop illumination could be made to approximately comply with settled rule with protection assured equal to that existing at present, and yet with less gloom about the streets. This was the feeling at the meeting last Tuesday, when the current lighting conditions were under discussion, upon an introductory communication by Mr. Leon Gaster, the Hon. Secretary.

Before this reduction of lighting, the night illumination of the streets of London and elsewhere had risen to the highest degree (not the highest possible degree) in point of volume and quality ever witnessed in them. The public having become accustomed to this degree of illumination, and finding that it fits very well current circumstances and habits, are not to be consoled for its loss (though admitting the prudence) by anyone pointing out that the present dismal evening and night conditions are no worse than in the days of the flat-flame gas-burner, when things went very well. They may not be worse than then, but people do not now like such conditions, especially with the proximity of the opposite extreme from the present one with which to make comparison. All Londoners would be glad if, without impairing the conditions of safety, and without easing the bomb-dropper's task, expert illuminating engineers could assist the authorities in producing better conditions. There are, so far as street lighting goes, two things that have to be decided. The one is inseparable from the other. They are mentioned by Mr. Gaster: (1) How far is it necessary to diminish the total amount of light? and (2) how far is it possible to meet the requirements merely by re-directing the light? The two questions show the course in which Mr. Gaster's thoughts are running. The first one can only be answered by the man above in an air-ship, and not by the person walking in the street below. The point is the maximum illumination that can be allowed below and still render indistinguishable every important "landmark" by the aviator at any altitude. We are afraid the settlement of the permissible amount of light is one direction in which the illuminating engineer would fail the authorities, in that there cannot be many of them expert enough as aviators to conduct scientific observations from above. It is a pity; and there will certainly have to be a development of the accomplishments of the illuminating engineer if he is going to enter upon the task of bringing about the union of scientific street illumination and protection in times of war, with the airship as a factor in the problem. As to how far it is possible to meet the requirements merely by re-directing the light from street-lamps is a distinctly promising line for due investigation; for a rearrangement of the obscuring bands of high-power lamps might be made so as not to allow more light to escape, and yet give what does escape a better distribution in the street. This would be a decided improvement upon what is now to be frequently seen—concentrated light spots vertically under the lamps, and dense darkness between the lamps.

There are many other aspects of this question of reduced street lighting for protection from the enemy sailing above which will make well worth reading our abbreviated report of the discussion at the Society's meeting. But in connection with this reduction of lighting, there is one person for whom one cannot avoid feeling some amount of sympathy—that is the shopkeeper. He seems to be the shuttlecock in this matter. He has no definite instructions as to what he is to do, beyond that he must not have outside lamps, and that after six p.m. the interior lighting of his shop must be reduced and obscured so as not to cause reflection upon the pathway. The police are the arbiters of a sufficient compliance; and in some districts—however impartially the officers of the law, who are not highly trained specialists in illumination, try to perform their new duty—the result is distinctly interesting in its variegation. But, of course, the difficulty is to know how to prescribe any rule that could be without much trouble adhered to by the tradesmen, with normal variable lighting in their shop windows. It is no good speaking to them in terms of foot-candles; one might just as well send to the bulk of them the regulations printed in Arabic. Illuminating engineers would, we understand, like to help the authorities purely for the sake of taking some share in patriotic work; and, armed with proper authority, these gentlemen could act in advisory capacities (as Mr. Gaster says), and so obviate disputes, and if any did arise assist in their settlement. However, if all shops had concealed lights, instead of dazzling lamps in the range of vision, compliance with the demands of the authorities would be an easy matter. But they have not, although it would not be, for most tradesmen, a difficult matter to have their lights rearranged and concealed.

What the authorities appear to be aiming at is to keep reflected light off the pavements of the streets, as light in this position, the surveyors above inform them, gives a good indication of the width of the thoroughfares. If the prevention of reflected light in this position is the object sought for, then the plan of shop-window screening as described by Mr. F. W. Goodenough at the meeting as having been applied at one of the show-rooms of the Gas Light and Coke Company ought to be quite satisfactory for general adoption. The only objection we can see to it is that, unless the screens are movable, they would be an eyesore in the daytime, and would then diminish the attractiveness and display area of the windows. But we cannot reconcile with other instructions the desire to prevent reflection from shop windows on to the pavement. It was mentioned by Mr. Frank Bailey during the discussion that illumination from the street-lamps must not rise up the sides of the buildings more than 6 feet. If this be so, and if the lamps happen to be located over the footpath, then the pavements must in either case be illuminated, and so reveal the width of the street, equally with shop lamps.

There is one point the authorities should not overlook, and that is they should do all that is possible, consistent with safety, to enable the tradesmen to carry on business during the Christmas season. Money is wanted everywhere; and nothing more than is absolutely necessary should be done to keep money pent-up, when through trading it might be made to create more work, and so more money. Without commerce, things would come to a standstill; and Christmas commerce means much to many industries and to many people.

A Comprehensive Reorganization at Leeds.

THE new General Manager of the Leeds Corporation Gas Department (Mr. W. B. Leech) has not been many months in office; but he has already faced and dealt with what must, in the circumstances, have been to him a very disagreeable task, but one which most technically qualified men who knew the conditions of the Leeds works, and generally the line of operations, were aware would, sooner or later, have to be undertaken, to stop the drift of some years. No man with the ability to detect seats of leakage and of waste on the technical side, and indifferent methods on the commercial side, which were keeping the department's business from extending its base and progressing at the rate it should do in such a city, alive with works and workers, would be worthy the chief executive office in that department if he did not, seriously and persistently till accomplished, take in hand the requisite reformation. Mr. Leech has done so. He has done the work thoroughly; and his report has been endorsed in its every detail by Mr. W. R. Herring, who has checked conclusions, cost estimates, and possible economies from beginning to end. What is highly important, too, the Chairman (Mr. Alderman Penrose Green) and the members of the Gas Committee have backed-up their General Manager in a way which shows he has their full confidence in prosecuting his scheme of reorganization. This confidence will, in due season, be fully justified.

All over the report, purpose and reason are written, and so is condemnation. From it, there are several lessons to be derived in connection with the works. The first is the folly of retaining old plant in commission when it has become so uneconomical in comparison with modern types that its supersession would be a profitable investment. A second is that it is unwise to merely adopt plant of standard types without seeing that it fits economically into the system, or at any rate is furnished with the necessary auxiliary plant to enable it to be worked to the best advantage. A third is that it is no use having even good plant unless it is properly supervised, and the working adequately controlled and checked. It is from the details and the method of operation of plant that loss issues or maximum gain is derived. Structural and working detail and method are weaknesses that seem to have permeated the manufacturing system at Leeds. The New Wortley works stand out as the best that can be said for Leeds from the technical point of view; but even there Mr. Leech points to the waste that is proceeding in connection with the handling of coke from No. 2 retort-house—and a lamentable waste it is when, by the expenditure of only £7500, a saving of no less than £2500 a year is possible. It is a curious condition of affairs that allows a perpetuation of such uneconomy and monetary leakage in any large business concern. However, it is at the Meadow Lane works that the worst possible conditions are to be found. These conditions are summed up in the comprehensive and emphatic passage in the report: "The works "generally are in a poor state of repair, and, on every hand, "there appear signs of a complete absence of engineering "and scientific methods necessary for the economical pro-"duction of gas." In another place, it is asserted that the retort-benches lacked all intelligent supervision; and the methods of dealing with the gas from the retorts to the holder are deplorable. The details of defect are not pleasant reading. Indeed, the works need practically complete reorganization. The scheme that has been drawn up to this end will raise their capacity from 5 millions to 8½ millions; and when this has been effected, the York Street works, which are most uneconomical, will be closed as a manufacturing station.

Proposal is also made to reorganize and establish on a methodical basis the laboratory work of the department. It has hitherto been of a very spasmodic character; and there has been no adequate scientific qualitative control of material purchases and sales, of the manufacturing processes, nor of the production of gas. One instance is given in the report. In the supply district of the York Street station, a test revealed the fact that gas was being distributed containing no less than 39 per cent. of inert constituents. It would, we hope and fully believe, be difficult, searching the country through, to find such another illustration of consumers having delivered to them, and being called upon to pay for, gas containing 39 per cent. of constituents that are totally valueless to them, or a distribution system being loaded-up with so much worthless gas. We hope, however, this was an isolated instance; but if the indicated looseness in quality has been proceeding long, we are not surprised that there have been complaints on the part of the consumers, and that the Electricity Department have profited by the technical neglect in the Gas Department. True, save in the strike and other exceptional years, the normal rate of increase in consumption has been about 5 per cent.; but it is obvious that business has been lost that could have been retained, and business has not been obtained that it would have been quite easy to secure. For an industrial city, in the average consumption of gas per ordinary consumer, Leeds does not stand well; and the average per prepayment consumer is only about equal to village experience with agricultural labourers for consumers. There is thus (apart from industrial effort in the power and heating line) considerable room for the development of business with gas-cookers, gas-fires, and water-heaters, as well as with properly prepared and graded coke.

A constructive piece of work has been taken in hand by Mr. Leech; and we feel certain that the Gas Department of Leeds is about to enter upon the making of new history for itself, and earn rank with the most progressive of gas undertakings. What is proposed is going to cost money. At last week's meeting of the City Council, the Gas Committee (who naturally cannot be held responsible for technical *laches*) asked for authority to apply for the sanction of the Local Government Board to the borrowing of £114,717 for the reconstruction of the Meadow Lane Gas-Works, for £11,124 to expend in additions to and improvements of the carburetted water-gas plant, and a further £20,000 for the purchase of gas-stoves. The estimated savings from the expenditure amount to £27,148 per annum; so that there will be ample return, and some thousands to spare, to meet the capital charges. And, as Mr. Herring remarks, credit is only taken for direct economies arising from the adoption of special plant, while the scheme as a whole will result in collateral advantages in the cost of running the works which will materially increase the credit balance. No one who reads the two reports, with knowledge and competence to assist him, will doubt the accuracy of the forecast. Naturally the supporters of the Electricity Department in the Council do not like this new activity in the Gas Department. The last thing they evidently desired to witness—partizan-like, but not statesman-like—was the best interests of the citizens served by the raising of economy and efficiency in the Gas Department, because economy of production, combined with quality of commodity and an enlivened and enlightened commercial gas policy, will make the trade development of the Electricity Committee the more difficult. That is not the business of the Council; their business is to render, through any and every one of their trading systems, the greatest good to the greatest number at the lowest possible paying price. Only thereby is municipal trading service fully justified. The partizan obstructionists to the reform of the Gas Department, fortunately for the good name of Leeds, found themselves, at the meeting of the Council, in a minority; and politic reasoning carried through the recommendations. Upon this, we heartily congratulate the Gas Committee and their General Manager; for they have set their hands to a large work which will (as well as being of considerable value to the citizens) redound to their credit throughout the gas industry.

A Study of the Boys Calorimeter.

WE print with great pleasure, on another page of to-day's "JOURNAL," a communication from Mr. E. F. Mueller, of the Bureau of Standards, Washington, on "Industrial Gas "Calorimetry," which deals almost wholly with the Boys calorimeter. It is a sequel to a communication by Messrs. C. W. Waidner and E. F. Mueller on "Industrial Gas Calori-"metry" in general, which appeared in the "JOURNAL" for April 14 last (p. 101). In their communication the authors stated that: "Several careful comparisons with the Junkers "calorimeter showed that the heat losses from the Boys "calorimeter were very appreciable, since the observed heat-"ing values found with the Boys calorimeter were about "2 per cent. lower than those found with the Junkers "calorimeter."

Having regard to the fact that the Boys calorimeter is the instrument with which the testings of calorific power are carried out in the official gas-testing stations in London and many other places in Great Britain, this conclusion was sufficiently disconcerting to all whose interest or duty it might be to see that the gas was duly credited with its true or total heat value. In an article in which we drew attention to the importance of the issue thus raised, we pointed

out that Mr. J. H. Coste, who had had wide experience of the Boys calorimeter, had found that it gave results in close agreement with those of the Junkers instrument; and in view of this and other testimony to the accuracy of the Boys calorimeter, we suggested, as a possible explanation of the low results found by Messrs. Waidner and Mueller, that the particular specimen of this calorimeter used by them may have been faulty in some respect. The suggestion was made with all reserve, as we presumed they had taken all proper precautions in regard to the instrument; but with the data available to us at the time, no other explanation of the discrepancy between their conclusions and those of other observers presented itself. The paper by Mr. Mueller, which is printed to-day, gives a record of work which has been undertaken partly for the purpose of answering the questions raised in our article; and it disposes at once of our suggestion that the particular specimen of the Boys calorimeter previously employed differed seriously from other specimens.

Mr. Mueller now gives the results of tests of town gas made with three different Boys calorimeters, all of Messrs. J. J. Griffin and Sons' make, in comparison with results obtained with a Junkers calorimeter. The Boys instruments were found to afford figures for the total heating value of the gas which were 1·2, 1·9, and 2·2 per cent. lower than the Junkers results. It is obvious, therefore, that the Boys calorimeter does not give correct or trustworthy results, assuming that Mr. Mueller has used it in his tests in a proper manner—*i.e.*, as intended by its designer. It is well recognized that the Boys calorimeter has been designed for official testings in which a certain routine is invariably followed; and it is not readily adaptable to the varied conditions in which portable calorimeters of the Junkers and Simmance-Abady types may quite properly be used with good results. Nevertheless, there is, as we said in our previous article, no place for the Boys calorimeter, even in official testing-stations, if it gives results which are over 1 per cent. low in normal conditions of use, or even when small departures are made from them. Before condemning the instrument, however—more especially having regard to Mr. Coste's earlier testimony to its accuracy, and to Dr. Davidson's confirmatory figures, which he was kind enough to send a little later [*vide* "JOURNAL," Vol. CXXVI., pp. 268 and 347]—it is only fair to it to make sure that Mr. Mueller's unfavourable results were obtained in conditions of use approximating to those for which the calorimeter was originally designed, and in which it is always used in this country. Mr. Mueller has been good enough to give in his paper details of the methods in which tests at the Bureau of Standards have been carried out. Had similar details been available to us in regard to the earlier comparisons of Messrs. Waidner and Mueller, we should not have been driven to suggest, as the only possible explanation of their results, that the Boys calorimeter with which they had worked was abnormal in some important respect.

The Boys calorimeter was designed in the first instance for use in making testings of calorific power in the official testing-stations in the Metropolis; and it has been used there according to certain definite instructions issued by the Gas Referees, of which body the designer of the instrument, Mr. C. V. Boys, F.R.S., is a member. We are not aware of any directions for its use other than those embodied in the Notification of the Gas Referees, and as Mr. Mueller in his paper refers to this document he had cognizance of them. These directions show that, in the official testings at least, only a small latitude is allowed in the variations in certain of the conditions of use which are under the control of the observer. Naturally one would expect that Mr. Mueller would have worked within the range of variation of conditions of use laid down in the directions. What, however, do we find, if we take even only one or two of the more important of these conditions?

The rate of flow of water through the Boys calorimeter in Mr. Mueller's tests is shown, from Table II. on another page, to have been from 119 to 135 lbs. per hour. The Gas Referees' directions prescribe that the rate of flow is to be regulated until it falls between figures which are equivalent to 53 and 63¾ lbs. per hour. Why did Mr. Mueller choose to double the rate of flow of water through the instrument? The rates of gas consumption in Mr. Mueller's tests were 2·9, 3·2, and 4·1 cubic feet per hour. The Gas Referees' direct that one-twelfth of a cubic foot of gas shall be consumed in between 60 and 75 seconds—*i.e.*, that the rate of consumption shall be between 4 and 5 cubic feet per hour. Why did Mr. Mueller choose, in two of his three pairs of tests, rates of gas consumption considerably below the 4 cubic feet per hour minimum? Did it not occur to him that his tests showed that the more he departed from the prescribed rate of consumption, the magnitude of the error which he found increased? Thus with a rate of 4·1 cubic feet per hour, he reports an error of − 1·2 per cent.; with 3·2 cubic feet per hour, an error of − 1·9 per cent.; and with 2·9 cubic feet per hour, an error of − 2·2 per cent. It was surely a striking coincidence that the error increased with the extent to which Mr. Mueller departed from the official directions for the use of the instrument.

The Gas Referees direct that a correction shall be made to the observed value, based on the difference between the temperatures of the air of the room and of the effluent gases. This correction is stated to have been found by experiment, and obviously takes account of losses or gains of heat through the effluent gases, radiation and convection from the instrument, &c. Mr. Mueller does not apply this correction. In the form in which it is given by the Gas Referees, it appears to be applicable only to the prescribed quantity of gas—viz., one-third of a cubic foot for a test; and as Mr. Mueller elected to make his tests on other quantities—viz., between one-sixth and one-fifth of a cubic foot, it becomes practically impossible to apply the necessary correction to his results. It is obvious, however, that it would wipe out a large part of the error with which he credits the Boys instrument.

Another point of importance is the temperature of the room and of the water supply to the calorimeter. In Mr. Mueller's tests, the room temperature ranged from 87·1° to 90·5° Fahr., which would very rarely indeed be reached in testing-stations in this country; and the inlet water from 86·43° to 91·07° Fahr., which would never be found in the water supplies here. The example of an actual test given by the Gas Referees in their Notification (p. 36) shows a room temperature of 59° Fahr., and an inlet water temperature of 47·2° Fahr. If these may be taken as typical figures, it is not unlikely that the correction for differences between the temperatures of the room and of the effluent gases would require modification if either were so much above the temperatures common here as were those prevailing in Mr. Mueller's experiments.

To sum up, Mr. Mueller has demonstrated that, as he has used it, the Boys calorimeter gives low results. He has not shown, however, that it gives low results when it is used in the manner prescribed by the body of which its designer is a member. He has been unfair to it in condemning it in general terms on the results of experiments in which he may not unfairly be said to have misused it. But we freely admit that his and other investigations suggest that now that the method of testing to be followed in London *must*, by Act of Parliament, be one which gives the *total* heat value of the gas, it is highly desirable that the limitations of the Boys instrument should be recognized and that it should be discarded—unless further evidence is forthcoming that it does give the total heat value through all the variations of conditions of testing which are likely to arise in a properly equipped testing-station in this country.

Corrosion of Retort Materials by Salts.

A USEFUL contribution is made to our columns this week by Dr. Alfred B. Searle on the subject of the corrosion of refractory material by salts in coal or coke, to which our contributor has been directing research for the last three years. Notwithstanding the time he has devoted to the investigation, he declares the matter is one which "should receive "even greater attention than has already been given to it," which indicates that he does not consider he has experimentally fathomed all there is to learn about the question. However, what Dr. Searle has already done opens our eyes to several important facts, and incidentally shows the gas engineer, and probably some of the manufacturers of retort material, that their knowledge concerning the conditions which contribute to corrosion by salts in coals has been of a somewhat superficial order. There will be indebtedness to our contributor in that he shows that both the manufacturer of the refractory material and the gas engineer can exercise some controlling influence over the conditions and reactions that contribute to the ill-effects upon the material. Experiences in this connection, using fireclay or silica, have been apparently very contradictory, and in gas-engineering

circles there has been an absence of satisfactory explanation as to why this should be. Indeed, it would be very difficult without a thorough investigation—there being so many factors (temperature, chemical, and physical) which may contribute to damage to retort material by the action of salts—to conclusively explain why corrosion is greater in one case than another, though on the surface there appears to be a similarity in conditions.

Irregularities of temperature, duration of contact, distribution of salts in the coal, and constitution of material may one or all account for experienced vagaries. For example, as Dr. Searle says, a corrosive salt heated for a longer period, and at a higher temperature, in one case than in another, would have a more violent action. The salts in coal, too, vary in their composition, and in their action. Damp coal has also a more corrosive action on the retorts than dry coal, because the moisture is (our contributor says) a "valuable" assistant in facilitating the reaction between the clay or the silica and the salts. The salts being in almost every case soluble in water enter into solution with it; and so the moisture serves as a vehicle for the transmission of the salts from the charge to the retort. Therefore the responsibility rests upon the gas engineer to see that his coals, if they are known to contain an appreciable amount of soluble salt, are not wet when charged into the retorts. But we are afraid there are not many gas engineers who trouble to ascertain the salt content of the coals they carbonize. On the other hand, the manufacturer of the retort material can do his part in producing retorts that are as slightly susceptible as possible to the action of the saline constituents of the coal. He can do this in various ways. But principally by giving consideration to the amount of reacting material present in the material of the retort as an impurity, and to the physical condition of the particles of the retort material. On the question of suitable particles and texture, Dr. Searle has a great deal to say that should be helpful to the refractory material manufacturers.

This reference to and indication of the lines taken in the contribution will direct attention to the article and to a subject which, in our opinion, has not hitherto received sufficient attention at the hands either of the makers of refractory materials for coal carbonization purposes or of those who have to use such material.

Gas-Works Destruction and Oil-Tank Protection.

The new Order in Council (issued under the Defence of the Realm Consolidated Act, 1914), which invests the Army and Navy with large powers, is a comprehensive document; but it is just as well to have this consolidation of prior Orders, together with the more explicit statement of principles and powers. It is not anticipated, though the power is conferred, that either the Army or the Navy will have occasion to take possession of any gas, electricity, or water works, and to place them in a condition of defence, nor to request the engineer of (say) a gas-works to prepare a scheme for destroying or rendering useless the equipment or facilities. The best scheme, for all the mischief a gas-works could do in war, would be to leave the plant standing until misadventure in the shape of a few stray shells put them out of working condition. The bombardment of Antwerp did not do any considerable damage to the gas-works—not more than about £2500 worth, to one station, though about forty shells fell in it; and the citizens were not left long without a gas supply. If any other scheme for the destruction of the works had been put into execution, the people of Antwerp would have suffered more than they have one from the deprivation of light, heat, and power. There can be no question now as to the inclusion of gas-works oil-tanks in the order requiring the construction of retaining-walls or embankments round the tanks to prevent the escape of the liquid, in the event of any mishap to the tank.

Verticals for Small Works.

Experience and example are crushing-out the old belief that modern carbonizing plant and operation are not for the small-capacity works. Information has been supplied before in our columns which shows the belief to be erroneous; and the particulars published last week (p. 496) regarding the Woodall-Duckham verticals at Spalding are sufficient to cause the complete collapse of any notion as to economic inapplicability. The plant only contains two settings of two retorts; the nominal capacity being 240,000 cubic feet per day, with a possible speeding-up to 310,000 cubic feet. The working of the plant puts completely into the shade the results from the old horizontal settings; but as these were probably somewhat old-fashioned, both in type and method, the comparison, of course, is the more favourable to the vertical installation. The point, however, is as to whether the working of the new plant has justified both the change and the Engineer (Mr. H. R. Wimhurst). The figures published a week ago are conclusive on this point; and we undertake to say that beyond the figures, Spalding is to-day supplied with a more uniform quality of gas than was the case with the old form of horizontals. Moreover, the figures for the first year—and such a year as this has been!—are not altogether fair for comparative purposes. As Mr. Wimhurst says, it takes time to "tune up" a new plant; and with the poor residuals markets early in the year, and the further collapse through the war (unless Spalding has been specially favoured), the working balance-sheet must be affected. Another year, and a normal one, there is confidence that the figures will come out even better than those already recorded. There is a further point about the plant. Two men are able to operate it, and do all the work in a twelve-hour shift from the coal-store to the coke-heap. This does not leave room for any economy, even by telpher plant, which is finding its way into much smaller works than it was possible for its precursors, in the shape of coke-conveyors, to do with their heavy maintenance costs. It is not often that we permit ourselves to make reference to advertisements in the editorial columns; but we cannot help saying that the reproduction of the photograph of the Spalding installation appearing elsewhere to-day is very striking. A vertical installation in a tower-like building certainly makes a new feature for small gas-works.

Capital Raising During and After the War.

On this subject, which has been under discussion in our columns recently [see "Editorial" in the "JOURNAL," Nov. 3, and Mr. Herring's letter and the leader last week], it is interesting to learn from the communication to our "Correspondence" columns to-day by Messrs. R. W. Cooper and Sons, Parliamentary Agents, that one Bill in the current session proposes to give to the directors of the promoting company some measure of relief from the auction clauses, though in this case apparently it is not possible to suggest some further relief through the suspension of the sliding-scale to the extent that the war is directly responsible for any increase in the price of gas. With this proposal (which was the main point in the first editorial on the subject), Messrs. Cooper are in full accord. There is one remark in our correspondent's letter which we think is due to a misinterpretation of what Mr. Herring said. Messrs. Cooper remark: "Mr. Herring will, however, forgive our reminding him that the proportion of loan capital permitted by the 'Model Clauses' is one-third, not one-fourth." What Mr. Herring said was that "by the powers enumerated in the 'Model Clauses,' gas-works capital is now based on the principle of 75 per cent. of ordinary or preference stock and 25 per cent. of loan capital." Mr. Herring is right with his percentage, and so are Messrs. Cooper with their proportion. The clause says "one-third part of the amount of the capital which, at the time of borrowing, has been raised." "One-third part" of an already issued capital of £3000 is £1000; and £1000 is 25 per cent. of the total capital and loan issues of £4000.

Cutting-Off Gas in Railway Carriages.—Herr Emil Schwyzer has taken out a French patent [No. 470,113 of 1914] for a safety device for use on vehicles for automatically cutting off the supply of gas, in case of accident (by means of a weight or pendulum actuated by the concussion), and so preventing fire. The weight is so placed that it can swing in all directions and act upon a part which releases a spring valve to close the pipe. Other methods of effecting the object are described in the patent specification.

German Administration of Gas, Water, and Electricity Works in Belgium.—It is reported in the "Journal für Gasbeleuchtung" for the 21st ult. that Herr Hans Drape, the Manager of the Lüneburg Corporation Light and Water Works, who had already received distinctions for service at the front, has now been transferred to the Civil Service of the German Government at Brussels. He has been entrusted with the supervision and administration of the gas, water, and electricity works throughout Belgium as well as the supervision of the electrical transmission stations and tramways.

PERSONAL.

Sir CORBET WOODALL, D.Sc., was on Tuesday last elected an Honorary Member of the Illuminating Engineering Society, as was also Mr. T. A. EDISON.

At last Tuesday's meeting of the Institution of Civil Engineers, Mr. HARRY OSWALD CARR, the Engineer of the Wandsworth, Wimbledon, and Epsom Gas Company, was elected a member.

Mr. T. F. BURTON, B.Sc., has been appointed by the Council of the Society of Chemical Industry as Editor of their "Journal" in place of Mr. Watson Smith, resigned. Mr. Burton will take up the duties of the position with the New Year.

Mr. HORACE LONG, who has been for the past eight years Secretary of the Redhill Gas Company, and whose service with the Company has extended over a quarter of a century, has been appointed (by examination) a Fellow of the Chartered Institute of Secretaries.

Mr. T. R. DAVIES, the Chief Rental Clerk in the Birmingham Corporation Gas Department, has retired owing to ill-health. He entered the service of the Corporation in October, 1876, as rental clerk, and held this position till 1891, when he was promoted to the "Gas Supplies" desk at the counter. In 1899 he was made Chief Rental Clerk and Assistant Office Superintendent.

Mr. J. E. L. COOPER, who has been for sixteen years in the service of the Yeadon and Guiseley Gas Company, has been appointed Manager and Secretary, in succession to the late Mr. Edward Lister, under whom he received his training. He studied at the Leeds Central High School and in the Technical Evening Schools, and passed first class in the Honours Grade in "Gas Manufacture" at the City and Guilds of London Examinations.

Mr. T. BANBURY BALL, the Engineer and Manager of the Rochdale Corporation Gas Department, who has latterly been in somewhat indifferent health, has been granted leave of absence to undergo a special course of treatment prescribed by his medical advisers. The Gas Committee have expressed their hope that he may soon return to duty fully restored to health. Mr. Ball has been at the gas-works over 33 years; and this is the first time he has ever sought special leave from duty.

We learn from the "American Gas Light Journal" that the authorities of Kalamazoo (Mich.) have written to Mr. WILLIAM NEWBIGGING with the view of engaging him to go to America and act as their expert in the gas-rate inquiry. He has sent them estimates covering plants fully equipped with the latest improved machinery for efficient manufacture, omitting the cost of sites and without the necessary mains. Fully-equipped works, with a capacity of 400 million cubic feet of gas a year, according to Mr. Newbigging's estimate, would cost approximately £139,000; if capable of producing 500 millions, £170,000; while a 600,000 million cubic feet plant would cost £200,000.

At a recent meeting of the Special Committee on Superannuations of the Glasgow Corporation, a letter was submitted from Mr. J. FLEMING, the Treasurer of the Gas and Electricity Department, intimating his intention to retire. It was unanimously agreed that he should retain his position until the appointment of his successor, and receive a retiring allowance of £340 per annum. Mr. Fleming, who is seventy-one years of age, was a clerk in the employment of the old City and Suburban Gas Company, and when their undertaking was acquired by the Corporation in 1869 he entered the municipal service. In 1889 he was appointed Treasurer of the Gas Department; and when the Electricity Department was started in March, 1892, he became Treasurer of that likewise.

Midland Junior Gas Association.—At a meeting of the Midland Junior Gas Association next Saturday afternoon, Mr. W. B. Cobb, of the Birmingham Corporation Gas Department, will read a paper on "Gas-Heated Hot-Water Appliances."

Scottish Junior Gas Association (Eastern District).—The first quarterly meeting of the session will take place next Saturday, in the Masonic Hall, Kirkcaldy; but members will assemble at the gas-works. Mr. Henry Rule, of Kelty, will read a paper entitled "A General Study of Figures in Relation to Gas-Works Practice;" and at the close of the meeting the members will be the guests of Mr. James Kincaid at tea.

Preston Gas Company's Rating Appeal.—Since the publication of our report of the proceedings in this appeal, as given in last week's "JOURNAL" (pp. 487-491), we learn that, in addition to Mr. Farady, Mr. Frank Ryde and Mr. Arthur Valon were retained by the Company; and had the case not prematurely concluded, both these gentlemen would have given evidence. As it was, the settlement took place while Mr. Farrady was in the box.

Private Bill Legislation for Next Year.—There is a decrease of 82 in the number of Bills, with accompanying plans, which have been deposited in the Private Bill Office in accordance with the Standing Orders; the figures being 109, compared with 191. The chief drop is in Railway Bills—4 against 23; and of miscellaneous Bills, relating to lighting, water supply, &c., there are only 25, instead of 50. The Provisional Orders are 74, against 114.

THE GAS INDUSTRY AND THE WAR.

New Orders in Council (made for the public safety, under the Defence of the Realm Act) have been published, revoking, but to a great extent embodying, others which have been in force. It is provided, among other things, that the competent naval or military authority may order that lights shall be extinguished or obscured, and that all persons in specified areas shall remain within doors. Persons controlling any harbour, dock, water-works, gas-works, and electric power station may be required to prepare a scheme for destroying or rendering useless the structures. There are, besides, regulations governing the acquisition of land and buildings by the military authorities. The authorities may "take possession of any buildings or other property, including works for the supply of gas, electricity, or water, and of any sources of water supply." Other Orders relate to the control of lights and the storage of inflammable liquids. Every place used for the storage of petroleum, turpentine, methylated spirits, wood naphtha, or any other highly inflammable liquid exceeding in the aggregate 100 gallons, is to be "surrounded by a retaining-wall or embankment so designed and constructed as to form an enclosure which will prevent, in any circumstances, the escape of any part of the petroleum or other inflammable liquid."

Lieutenant D. M. Carr, of the Royal Engineers (Territorials), the Manager to the Ormskirk Gas Company, has been promoted Captain and Adjutant.

Mr. Donald Mackenzie (son of Mr. A. Mackenzie, of Messrs. Alder and Mackay) is on active service with the Artillery; and he has already been to France and back.

It was mentioned last week that Mr. G. D. Bidwell, of Messrs. Falk, Stadelmann, and Co., had been given a commission as Lieutenant in the Fifth Battalion of the Wiltshire Regiment. We learn that the firm's representative for the Midland district, Mr. W. J. Bull, was in the Royal Naval Reserve, and was at Antwerp. He is now interned in Holland. Upwards of a hundred of the firm's employees have joined the Colours.

The Roll of Honour of the Hornsey Gas Company, a copy of which has been forwarded by the Engineer and Manager (Mr. J. W. Buckley), shows that no less than 28 of the Company's employees have joined H.M. Forces; while eight more endeavoured to enlist, thus showing their anxiety to serve the country. Mr. L. C. C. Preedy is a Second Lieutenant in the Tenth Middlesex Regiment; while Mr. J. T. Horn is a Quarter-Master Sergeant instructing Royal Engineers. As far as practicable, the positions of the men will be open to them on their return. Where there are dependants, the Company are paying full wages, less the State allowances. The Company have contributed £250 to the Prince of Wales's Fund and £30 to the Red Cross Fund. In addition, they have fitted up, free of charge, a number of houses for lighting, heating, and cooking for the Belgian refugees and for other institutions consequent upon the war.

A Reuter telegram received from Petrograd yesterday stated that in the bombardment of Lodz, in Poland (a town having a population of 700,000), many houses had been destroyed and the gas-works set on fire. The consequence was that the town was without a supply of gas.

A curious story was lately told to a correspondent of a London daily paper by a wounded man belonging to the Cheshire Regiment. He mentioned that many of the men came from round Northwich, where Messrs. Brunner, Mond, and Co.'s works are situated, in which nearly everybody in the place is employed. The wounded man said they caught a German one day, and one of the Cheshires recognized him at once, and exclaimed: "Why, I worked with him at Brunner's!" This was perfectly true; they had worked side by side.

The Bermondsey Borough Council have decided to support the Islington Council in their appeal to the Government to sanction such an improvement in the lighting of public thoroughfares as may be commensurate with the reasonable protection of London. When the matter was agreed to by the Council, Mr. Layman inquired if a reply had been received from the Chief Commissioner of Police with reference to the request of the Council that he should consent to the lights in the borough being increased. The Town Clerk replied that a formal letter of acknowledgment only had been received. Mr. Layman added that Bermondsey was the darkest borough in London. He proposed that the Town Clerk should again write to the Chief Commissioner of Police asking him to at once give permission for the lights to be increased. Mr. Delderfield, in seconding, thought the Council ought to light up, and take the consequences. People had now got some idea of what humbug the whole thing was. Mr. Earthrowl said the special concession as to shop lighting was not in force in the borough, and tradesmen had had to turn out the extra lights in their shops. The resolution was unanimously carried.

According to paragraphs which have appeared in the Blackburn Press during the past week, the promised start with the Munich system of gas making has not yet been made at Darwen; and the

internment of several Germans employed on the work has delayed its completion. It has transpired, says one paper, that a Gas Sub-Committee have had before them a letter from Messrs. R. & J. Dempster in reference to obtaining the services of three of the German workmen interned some weeks ago, in order to enable the new chamber-ovens to be heated-up and set to work. The firm asked the Corporation to support them in their application for the release of the men. The Sub-Committee instructed the Town Clerk to take such action in support of the application as he may deem necessary. This recommendation will come before the Council for confirmation at an early date.

The Lincoln City Council have approved a resolution of the Council in committee to forthwith insure the water-works, gas-works, and electricity works against loss or damage by aerial craft, at a premium of £200 a year. Mr. Baker thought that this was a fabulous sum to pay for such insurance; but Alderman White pointed out that it covered property representing £161,000 in value, and added that "one did not know what might happen." The Belfast Gas Committee have insured their tanks of oil for a sum of £15,000. As they have at the present time about £20,000 worth of oil in store, they think it unwise to run any risk, however slight this risk may be.

The problem of the continued enlistment of Wallasey Corporation employees was dealt with in a statement presented to a special meeting of the Council in committee by Alderman Sidney Dawson (the Chairman of the Finance Committee), following an interview with the War Office authorities. It seems that no fewer than 318 Corporation employees have already enlisted, many of them being skilled men whose places it is difficult to fill. Reference was made to the importance of efficiently maintaining a erry service which conveys 50,000 passengers per day, of continuing a full supply of gas which is used not only for lighting but also for cooking purposes by 15,000 out of 19,000 householders, and of maintaining the supply of electricity for lighting and traction purposes; and it was pointed out that all municipalities are feeling the effect of recruiting. Thus the difficulty of finding substitutes for those who enlist is increasing daily, as men are naturally unwilling to leave permanent employment for temporary positions for the period of the war; the Council having promised to keep the positions open for the men who have enlisted. In these circumstances, the Council have decided that, as the various staffs have been already so seriously depleted, men who enlist from now should not be those occupying positions of importance which cannot readily be filled, and that all further recruits shall be entitled to one-third Council pay, *plus* army pay and separation allowances, instead of the full-pay terms previously granted. The full pay will, of course, be continued to those who have already enlisted.

The Halifax Corporation are allowing the Belgian refugees in the town to have the use of gas and the tramcars free of charge.

In addition to what they are already doing for employees who have joined the Colours, the Oldham Water Committee have now decided, on the recommendation of Mr. Arthur Andrew (the General Manager), to lay pipes free for the Oldham Comrades' Battalions at Chadderton Park. The Committee also determined that water be supplied free to all houses, &c., fitted up for the reception of Belgian refugees.

The Bolton Corporation Water Committee readily acquiesced in a suggestion made by the Farnworth Urban District Council that a water supply should be given without charge to an institution in their district where Belgian refugees are housed. It was also decided, on the application of the Bolton branch of the British Red Cross Society, to give a free supply of water to a local hospital.

The Lytham District Council desired to give coke free to the dependants of the Lytham soldiers and sailors at the front; but the Local Government Board have informed the Council that they do not know of any powers enabling them to do so. At the meeting of the Council on Thursday last, there was much resentment at the veto, especially seeing that free gas is being supplied to houses used for Belgian refugees.

The request of the Military Authorities that the lights on piers, promenades, and other public places in towns on the Devon coast should be reduced, has been discussed at the meetings of several of the local authorities. At the Teignmouth District Council meeting, some of the members complained of a want of uniformity in carrying out the wishes of the authorities. While the sea-front at Teignmouth was in darkness, neighbouring places had done nothing, and were displaying as much light as usual. Particular reference was made to the action of the Dawlish Council, who, however, met later in the week and decided that the lights should be reduced. Since then the Teignmouth Council have received a letter from Major-General Penton, commanding the military defences, praising their patriotic spirit, and saying that he only wished other places had acted in a similar loyal manner. General Penton explains that he had issued a request to loyal subjects rather than an order; but he is now in communication with the Chief Constable of the county on the matter.

ELECTRICITY SUPPLY MEMORANDA.

ACKNOWLEDGMENT has already been made of the obligations of the gas industry to the Long Eaton Gas Company for bringing the District Council and their illegal commercial tactics in connection with electricity supply before the High Court; and the obligations of the whole industry are also due to the Council for their inestimable, but inexplicable, action in taking the matter to the Court of Appeal. As we have pointed out several times, the Long Eaton Council are not the only offenders in this "undue preference" business in electricity supply; and there are several other tariffs in existence that require adjustment. However, the first fruits of the judgment are now maturing in other quarters. In March last, as we announced in the "Memoranda" at the time, the South London Electric Supply Corporation gave notice to householders in their area that the price for the supply of electricity for lighting purposes would, in consequence of the continued high cost of coal and other commodities, be increased from 4½d. to 5½d. per unit as from April 1. The Company, however, expressed their intention (as other electricity suppliers had done before them) of granting a rebate of ½d. per unit from the 5½d. where the supply of energy was given to premises used entirely as private residences (such premises not to include flats, maisonnettes, or residences in the occupation of more than one tenant), *provided that only "the Corporation's supply is used as an illuminant* upon such premises, and the consumer *will undertake, in writing, to conform to this stipulation.*" This absurd and weak-kneed action on the part of the Supply Corporation has been criticized by us more than once; and the illegality of the preferential treatment has been suggested. Under it, one consumer of current for lighting purposes, with a few gas-burners about his premises, might be a larger customer of the Supply Corporation than another householder who only used electricity for lighting, yet the latter (and not the former) would be entitled under the offer to have his current at the preferential rate of 5d. per unit. The Legislature have never, in connection with statutory companies, allowed such distinction, which is altogether opposed to common commercial principles. It is understood that the Supply Corporation have now retreated from their penalizing position, and have by circular (upon the result of the Long Eaton appeal being known) hastened to inform their consumers that the ½d. rebate to whole electricity users for lighting must be withdrawn, as it is illegal. It does not speak highly of the administration of the Corporation that they should have let themselves into such a ridiculous position. If in future the Directors are incapable of judging what is, and what is not, "undue preference," they had better consult a legal authority who is able to properly construe for them the meaning of the words of statutes. We are almost sorry that this instance of undue preference has collapsed in this way (presuming our information is correct, and we have no reason to doubt it), as we do not think the South Metropolitan Gas Company would have allowed the preference, proposed for the purpose of injuring them, to continue without compelling the appearance of the Supply Corporation before the Courts.

Undue Preference and First Fruits.

[Since writing the foregoing, we learn that, on the 1st inst., the Electric Supply Corporation, Limited, made the following notification to their consumers: "We have hitherto allowed you a special rebate of 10 per cent. because you use electric light throughout your premises. A recent legal decision makes this rebate unlawful; and as we cannot afford to extend the 10 per cent. discount to all consumers, we have to give you notice that as from the end of this year, the special rebate will cease."]

Constitutional Defects.

The subject of room heating is an apposite one just now; and so attention is directed to heating apparatus in the "Cooking and Heating Notes" in the "Electrical Times." Electric radiators and other heating devices of the same family have now been on the market for some years. But despite the fact that they do not (as electrical intelligence believes to be the case with other forms of heater) "consume" the oxygen of the atmosphere, and leave the other 79 per cent. of the constituents of the air hanging about oxygen bereft, despite the fact that they do not send up the chimney (so electrically described) "poisonous" carbonic acid and water vapour, despite the facts that they are terribly bad servants as heaters in the winter and most uneconomical, and despite the fact that they do not aid ventilation and help to keep the air of rooms in motion, they do not gain in popularity at the same rate as the gas-fire. In the new types of electric "fires," there is a disposition to make greater use of incandescent elements in place of bulbs (the form of which has its prototype in a succulent production of German origin), and to go in for higher loading. Higher loading is necessary to obtain more heat than hitherto. But this means increased consumption; so that, even charged at ½d. per unit, the cost for (say) a fourteen-hour run per day would be considerable, relative to an equal duty from other forms of heaters. The writer of the "Notes" before us makes some critical observations upon the new types of electric heaters. Working at higher temperatures, he submits that portability is a danger. If the stove with flexible connection is moved about a room, it may become so hot as

to be capable of damaging, if not of setting fire to, furniture or fabrics, if placed too close to them. Then stoves of this kind should have more substantial casings than they are usually robed in—casings somewhat larger than is customary at present in relation to the electrical capacity and dimensions of the elements. Makers are listing such heaters rated as heavily as 3 kw., with case-work no more robust or larger than a stove designed for only 1 kw. rating. Then the wire gauze over the elements is not placed a sufficient distance in front to obviate danger. Those heaters, with incandescent elements, in which no provision is made against contact, are described as "highly dangerous." Then there is a suggestion that the case of the stove should be well ventilated at the bottom, and around the upper part of the frame, in order to secure ample air circulation, and keep down the average temperature of the interior fittings and metal work when in use. With what result? That the same disagreeable effect would be experienced by users as was the case when a few years ago the air of rooms was drawn through the casings of gas-fires—the humidity of the air was destroyed to such an extent that people complained of what was called the dryness produced by gas-fires. However, some method of cooling appears to be absolutely essential, and not on account only of the internal fittings. Owing to the great heat, the ironwork becomes blue, flex ends are damaged, and trouble arises owing to the difficulty of keeping mechanical contacts tight. Then the heat from these stoves is so precious that makers are advised to do something to avoid its loss up the chimney, when the stoves are placed on the hearth, in the event of the register being open or "leaky." We should prefer the register always open for health's sake, and not closed for the benefit of the electric-radiator. The article is one which should be circulated among electricity users as a warning against present types of electric heaters.

Outside Lamp Charges and Use Prohibition.

A point for consideration is as to the charging for contract outside shop lamps during the period of the prohibition of use. We do not suppose there will be any difficulty over the matter on the side of gas suppliers. Certain it is that tradesmen will not feel genuinely disposed to pay for lamps of which they have not had the advertising benefit; and certain it is that it will not be politic to squeeze the last possible penny out of them for the lamps. Future business has to be remembered. The Electricity Committee of the Fulham Borough Council have had the matter under consideration; and they have recommended that, in view of the reduction of outside lighting, agreements be suspended as from Oct. 1 for the period of the prohibition, providing that accounts on the basis of the charge for 500 hours per annum are paid, and that the consumer agrees to extend the contract for a year after the prohibition period. This last condition is important. It would not be fair that either one party or the other should be injured more than can be avoided through circumstances over which neither the one nor the other has any control. The temporary suspension of the contract should cause extension at the other end for a period at least as long as the suspension, and on the same terms. It would be interesting to hear from gas suppliers what terms they are arranging for officially extinguished shop lights under contract.

Lighting of the I.E.E. Theatre.

Readers of the "Memoranda" know what trouble and caustic electrical comment there have been over the lighting and ventilation of the lecture theatre of the Institution of Electrical Engineers on the Thames Embankment. The Institution, with all the wisdom and skill at command, could not straightway design a method of lighting for the theatre which would have made it a show-place for illumination. It was altogether deficient in practical result; and there has been nothing but complaint ever since the days when certain electrical contemporaries thought it their duty to point to it as a wonderful example of what lighting should be. The method was indirect lighting by metallic filaments located in the cornices, and quartz mercury lamps above the glass lights forming the main part of the ceiling. The latter lamps have now been replaced by other lights, and different coloured screens are used. But we are told this is only in the nature of an experiment; and it may not be the final method of illumination. Experimenting! And in these days of "illuminating engineers!" What is the good of illuminating specialists if success at this time of day is only to be achieved by the experimental process, involving both money and time expenditure?

Increase in Price.

Current conditions evidently begin to pinch in the case of electricity suppliers. Before there was any thought of war, some suppliers raised their ordinary charges on the ground that coal costs showed no disposition to recede to those ruling of yore. With (if the furnace equipment is not already suitable) a modest forced-draught arrangement, gas companies can supply central electricity stations with coke at a price which would be found more economical in relation to duty than coal at current and immediately past figures. However, our business is not at the moment to advertise coke in this particular connection, only it just crossed the mind on reading the principal cause given by the Westminster Electric Supply Corporation for proposing to increase the price of current to the City Council. The Supply Corporation say that, owing to the advanced price of coal and other expenses, they are unable to agree to the continuation of the contract with the City Council for one year for the supply of energy for lighting purposes at 2½d. per unit, and suggest that a new agreement be made for three years at 3d. per unit for lighting and 1d. for power purposes. The Contracts Committee have recommended the Council to agree to the revised charges, subject to the termination of the agreement, by giving three months' notice, expiring at the end of the first year or at the end of any succeeding year.

Portable Lamps and the Spy Scare.

The writer of "Installation Topics" in the "Electrical Times" is obviously quite anxious to supply fresh food for the spy scare. He has been looking round to see where he can find a new source of revenue for electrical contractors during a time of national anxiety; and he finds it in the darkened state of our streets. He says that the streets of London at night time now involve some risk for pedestrians, especially if they be shortsighted. Some form of portable lamp would therefore, he thinks, be of real value just now; and there is nothing to compare with the portable electric-lamp for convenience, cleanliness, and efficiency. These, operated by dry batteries or accumulators, could be carried in the pocket, and could be immediately switched-on when needed. What a profoundly intelligent suggestion! Fancy some dear old fumbler, masculine or feminine, myopic and nervy, walking along and suddenly producing a portable electric-lamp, and switching it on to aid in crossing the road. We picture the London crowd assembling to see the curiosity, we hear the word "spy," and we see the special constable who desires to have some deed of valour registered to his account, marching the short-sighted victim (who cannot, through shaky nerves, render an intelligent account of himself) off to the nearest police station to be interrogated as to his movements. Will-o'-the-wisps on the sea-coast would not be in it. Try again, Mr. "Installation Topics," and let the electrical contractor have a suggestion with a little more value in it than this one.

Dissension in Spring Gardens.

The notices of the applications by the London County Council for the blessing and consent of Parliament to the cumbrous scheme for bringing under one roof the whole of the electricity supply of the Metropolitan area and an extensive environment, have been referred to by most of our electrical contemporaries. Some are glad over the action of the Council; some are sitting on the fence; generally they are non-committal in their comments. Most of them appear to think there will have to be some transformation in detail before Parliament will endorse the scheme. It does not, however, seem to matter much to the County Council what other people think; they intend to go forward. The scheme is being fathered by the Municipal Reformers in the Council, who up to lately have, by way of change, had the support of the Progressives in this particular consolidation effort. But schism has already lifted its head. The Progressives assert that they have been trapped by the Municipal Reformers. The former have always held that the ultimate electric supply authority for London should be the Council; but the Municipal Reformers are not of this way of thinking. They prefer that the venture should at all times be shouldered by an outside body. Sir John Benn, the Progressive leader, holds that the Bill ought to be so framed that the final decision as to whether there shall be an ultimate vesting of the gigantic undertaking in the Council or in a separate public authority shall be left to Parliament. The Municipal Reformers are not prepared to take any risks. Within the Council Chamber there is, therefore, not likely to be a whole-hearted support of the Bill.

No Time for Adequate Consideration.

The outside quarters of disaffection over the Council's scheme are already disclosing themselves; and the first line taken for attack is that the whole matter is so far-reaching that there is not time—particularly in view of the circumstances which have produced such vast disturbance in the world, and which claim so much attention—to give the consideration to it that its importance demands. The Council, however, seem inclined to go forward on the plea of urgency, which urgency no critical outside observer can detect. Forcible procedure on the part of the County Council will not be of any avail, and is only likely to make still fiercer the already visible resentment. Protests against rush, and disagreement with the Council's proposals, daily break out in fresh places. A report by the Parliamentary Committee of the Surrey County Council is typical. The Committee are confident that there is not time to give the scheme serious consideration, and that "hasty and ill-considered legislation upon such a large question will only result in general opposition to a scheme which, if time had admitted, might have formed the subject of negotiation, and possibly of satisfactory settlement. The Surrey Council do not appear to want to show a leading hostility to the London Council; but they have now summoned a conference of Surrey authorities affected by the proposal, with a view to joint action being taken if the London Council persist in pushing forward the scheme. The Surrey Council are of opinion that the scheme should be deferred to the session of 1916, and that meantime the London

Council should furnish all the authorities concerned with the details of the completed scheme. This is, we rather fancy, just what the Council are not in a mind to do. The shorter the time that outside authorities have for the consideration of the details, the shorter the time for the preparation of opposition cases. The Council have lately had the opportunity of studying military strategy. The Law and Parliamentary Committee of the Hammersmith Borough Council likewise desire that local authorities and companies supplying electricity in the proposed area of supply should make strong representation to the County Council on the point as to postponement. The Council probably feel that local and personal interests are so deeply rooted and robust in connection with almost every undertaking that postponement would not do much, if anything, towards reconciling them to the project, and in producing something that could be taken to Parliament as a scheme accepted and favoured by all bodies in the extensive area proposed to be electrically monopolized by the new creation. In this belief, the Council may be disinclined to listen to their outside counsellors.

CONCILIATION IN LABOUR DISPUTES.

Some statistics relating to the strikes and lock-outs of last year were given in a recent issue of the "Journal" [*ante*, p. 424]. The particulars were taken from the annual report of the Department of Labour Statistics of the Board of Trade, which also deals with the more hopeful subject of Conciliation and Arbitration Boards. To this portion brief attention may now be devoted.

As time goes on, conciliatory methods tend to become more employed in connection with differences of opinion arising between employers and employed, although even now the extent to which such questions are decided by "peaceful" means is much less than could be wished, and should be attained. As a matter of fact, it is stated in the report that of the 1497 disputes which began in 1913, only 150 (directly involving 112,520 workpeople, or about one-fifth of the total directly involved in all disputes) were settled either by the intervention of third parties or through the agencies of various conciliation machinery. During the ten years covered by the statistics, there has been no other occasion on which the number of disputes settled by conciliation within a twelve months' period has reached 100. Thus 1913 marks a very substantial improvement on its predecessors. One of the principal features of the figures is the large number of building trade disputes settled by conciliation and arbitration last year as compared with the nine preceding years. In the mining and quarrying trades, more disputes were settled by these means than in the previous year; but the number of disputes and the number of workpeople directly involved were considerably less than had been the case on several occasions prior to that. The metal, engineering, and shipbuilding trades are well above anything already recorded for them. Looking into the matter more closely, it is seen that during the last few years the proportion of cases settled by methods of conciliation to those settled by arbitration has been steadily increasing; and in 1913 it reached the highest figure so far attained. In the twelve months, no less than 127 disputes were settled by conciliation, as compared with 23 by arbitration.

What has been said so far refers solely to those disputes where an actual stoppage of work had occurred which were settled by conciliatory means, including voluntary permanent conciliation boards and standing joint committees. The bodies named, however, have been called into existence primarily to act on the principle that "prevention is better than cure;" and they also do a great deal of work of a less prominent, but perhaps even more useful, character than that just summarized. The number of permanent conciliation boards and joint committees in existence at the end of last year, so far as was known to the Department, was 343; and the total number of cases considered by them (of which 2574 were settled) was 4070. This high figure was due, as in the two immediately preceding years, to the great amount of work carried out by the South Wales Tinplate Conciliation Board. There was also an increase in the number of cases considered by the Joint Committees in the Northumberland and Durham coal trade. During the ten-year period included in the statistics the proportion of cases settled by the boards to those considered varied from 43 to 78 per cent.; in 1913 it was 63 per cent. As usual, the cases dealt with by the boards varied very greatly in importance. In the coal mining industry, each of the two cases settled by the Board for the Federated Districts affected over 400,000 workpeople, while the majority of the cases dealt with by the Committees in the Northumberland and Durham coalfields were grievances affecting only a few workmen at individual pits. Under the terms of the Coal Mines (Minimum Wage) Act, 1912, Joint District Boards were established in 22 districts for the purpose of carrying out the provisions of the Act; but as these are not voluntary boards no particulars of their proceedings are given in the present report.

During the past year, 37 new boards and joint committees were established, of which 19 were in the building trades. In the same period, some three or four ceased to exist. Beyond the new boards, important fresh machinery was set up for dealing with disputes in connection with the agreement which brought to a close the metal workers' dispute in the Midlands.

INDUSTRIAL GAS POISONING.*

About twelve months have elapsed since we noticed the appearance of a translation by Dr. T. M. Legge, H.M. Medical Inspector of Factories, of Dr. J. Rambousek's handbook on "Industrial Poisoning." A great portion of the work was concerned with industrial gas poisoning, and we had occasion to point out that in many respects the information on this branch of the subject was inadequate.

The work of Drs. Glaister and Logan, on "Gas Poisoning in Mining and Other Industries," which is now before us, is far more exhaustive so far as gas poisoning in all its ramifications is concerned. Moreover, the authors appear to have approached the subject purely from the scientific man's standpoint, and not as preachers of a gospel of social emancipation to be achieved by penal legislation directed against luckless employers of labour. We can recommend the work to the very large circle of technical men who are directly or indirectly concerned with the occurrence of gas poisoning, but must warn other classes of readers that the descriptions of many industrial processes are by no means trustworthy.

In their preface, Drs. Glaister and Logan point out that while there has been much published abroad on poisoning by carbonic oxide and other gases, there is not much to show on the clinical side by home authors, if the writings of Haldane, Mott, and one or two others be excepted. In their first chapter they refer generally to the use of gas in industries, and to several cases of gas poisoning in the past in which miscarriage of justice has occurred through ignorance of the symptoms. The second chapter deals with methods of working collieries and the ventilation of mines. The account of the impurities of mine air appears to be excellent. Much of it is based on the investigations of Dr. J. S. Haldane. The third chapter refers to underground fires; and the fourth chapter refers to explosions in coal mines. In the fifth chapter causes of death in colliery explosions are discussed; and in the sixth chapter the authors describe the symptoms of poisoning by after-damp and by fumes from various explosives.

The seventh chapter refers to laryngitis, bronchitis, and other inflammatory ailments of the upper air passages which are frequently found among the survivors of large colliery explosions and others who have suffered from carboinc oxide poisoning. The eighth chapter describes poisoning by blast-furnace gas and by various producer gases. Blast furnace gas commonly contains about 28 per cent. of carbonic oxide, and, being virtually odourless, is therefore very liable to cause poisoning. Purified blast-furnace gas is now largely used for many industrial purposes on ironworks, or on other works in the vicinity of blast furnaces.

The authors then pass on to refer to illuminating gas; and, while the brief summary of gas-works processes is by no means clear, and the analysis given of typical coal-gas is unprecedented—in that the gas contains no carbonic acid and 1·5 per cent. of "CH_2" in place of the ordinary heavy hydrocarbons—the toxic ingredients are fairly correctly stated, and the dangers from coal gas are not exaggerated. The authors make some mis-statements in connection with carburetted water gas. For instance, they state that the "flame" of the gas possesses a decided odour. We are of opinion that, in regard to the composition of coal gas, carburetted water gas, and the mixtures of the two gases which constitute the town gas supply in many places, the authors would have been well advised to have secured the co-operation of someone having practical knowledge of these gases. As regards the dangers from different classes of gas they appear, however, to have grasped the salient points. An interesting case of carbonic oxide poisoning is recorded—due to the gases liberated from pitch which had been allowed to cool for over fourteen days in the tar-still in which the tar oils had been removed by distillation. The gas liberated from the pitch from the middle of the still was found to contain 10·7 per cent. of carbonic oxide. It is, of course, well known that entry of workmen into tar stills which have cooled down is attended with danger; but the danger of poisoning has not, so far as we know, been traced in other cases to the effect of carbonic oxide. It has frequently been attributed to sulphur and nitrogen compounds; but it is, of course, quite easy to understand that, if the distillation has been pushed to the point of partial carbonization of the residual pitch, the gas liberated will contain much the same proportion of carbonic oxide as does coal gas.

The ninth chapter describes the symptoms met with in men suffering from poisoning by fuel gases, and is certainly worth perusal by all those who may be confronted by cases of poisoning on gas-works—a subject with which the ordinary medical practitioner is generally quite unfamiliar. The tenth chapter refers to disturbances of the central nervous system following carbonic oxide poisoning, and is obviously of more value to the medical practitioner than to the gas manager. The same may be said of the eleventh chapter which describes mental disorders which may follow poisoning by carbonic oxide. The twelfth chapter relates to the serious question of chronic poisoning by carbonic oxide;

* "Gas Poisoning in Mining and Other Industries." By John Glaister, M.D. (Glas.), D.P.H. (Camb.), F.R.S.E., &c., &c., Professor of Forensic Medicine and Public Health in the University of Glasgow; Senior Medico-Legal Examiner in Crown Cases for Glasgow and Lanarkshire, &c., and David Dale Logan, M.D. (Glas.), D.P.H., Surgeon to the Coltness Ironworks, Newmains, &c. Edinburgh: E. & S. Livingstone; 1914.

and gas managers should, when reading it, have regard to what has been said in an earlier chapter about tolerance to carbonic oxide poisoning. The thirteenth chapter should be of considerable value, since it deals with the treatment of cases of gas poisoning. The next chapter, on the pathology of carbonic oxide poisoning, is more directly useful to the medical man; and the fifteenth chapter—on methods of detecting carbonic oxide in the body and in air and gases—is similarly of most value to the analyst. The sixteenth chapter describes various forms of apparatus for rescue work. This should be read with interest, though we have a strong impression that many forms of rescue apparatus which are highly recommended, and much used, require further investigation as to their efficacy in emergency conditions.

The book concludes with a comprehensive bibliography on the subject of industrial gas poisoning; as also an exhaustive index. The work generally leaves much to be desired, chiefly because the authors have not secured the collaboration of someone having a practical knowledge of gas manufacture and fuel gases. Hence they have made deductions as to the poisonous effect of certain gases which must be incorrect because they are based on assumptions, as to the composition of the gases in question, which are erroneous. Despite these very serious defects, we consider that the work is the best which has yet dealt with the subject of industrial gas poisoning.

A VISIT TO THE WAPPING GAS-WORKS

By the London and Southern District Junior Gas Association.

On Saturday afternoon, between forty and fifty members of the Association, headed by the President (Mr. J. Hewett, of the South Metropolitan Gas Company), paid a visit to the riverside works at Wapping of the Commercial Gas Company. The visit was one which it had been confidently anticipated would combine profit and pleasure; and this confidence proved not to have been misplaced. As far as the site is concerned, the works are in striking contrast with those on which most of the members of the Association are engaged; for there is hardly a square yard of space unoccupied. Dating back, as they do, to the early days of gas lighting in London, the works can claim an age which runs into three figures; but they are still "hale and hearty." Penned in on all sides by river, street, warehouses, and buildings of every kind, with only the barest possible amount of "breathing space," the Wapping Gas-Works in the work they accomplish show a record which keeps them right in the front rank.

The members assembled in the yard, and were welcomed by Mr. G. M. Gill, the Assistant Engineer to the Company, who has charge of the works. Then the inspection began, under the guidance of Mr. Gill, who was assisted in pointing out and explaining the features of the plant by Mr. A. E. Williams, Mr. Goddard (head foreman), and Mr. Cook. The carbonizing is carried out in two retort-houses, the maximum capacity of which is about 3,000,000 cubic feet of gas per day; and in addition to this there are two Humphreys and Glasgow carburetted water-gas sets, each of a nominal capacity per day of 625,000 cubic feet, but having a combined maximum daily output of 1,600,000 cubic feet. The pan breeze obtained on the works is treated in a "Notanos" washer, the working of which was carefully examined. It was, however, to the larger of the two retort-houses that attention was first devoted; and in this part of the works a good deal of time was spent, though none too much to get a fair acquaintance with all there was to be seen.

In the larger retort-house, there are fourteen Gibbons regenerator settings of ten through retorts. The stoking is done by Arrol-Foulis hydraulic charging machines and Williams-M'Phee pushers. The furnaces are filled by means of a Gill patent furnace-charging machine, which is carried on the side of the pusher. This machine was described on p. 353 of the "Journal" dated May 7, 1912; and in November of the same year Mr. Gill, in the course of a paper, placed further particulars and illustrations of the appliance before the members of the Southern District Association of Gas Engineers and Managers. He then stated that the object of the machine was to charge the furnaces with the hot coke as it came from the retorts—an operation usually attended with much physical exertion. In the case of the machine at Wapping, he added, expectations had been more than realized. The work was done more quickly; no more men were required in the "firing draw" than in the "ordinary draw;" and there was no hard work whatever involved in filling the furnaces. The very small cost of working the machine (the driving being by hydraulic power) was referred to; and figures to show its speedy working were adduced. In the same paper, Mr. Gill gave some particulars of the tar-tower arrangements and circulating pumps in operation at the works; and these were explained to the visitors on Saturday. In both houses there are pumps fitted up which flush-out all the tar-pipes leading from the hydraulic mains to the tar-towers.

Having had demonstrated to them the value of the furnace-poker as a substitute for particularly arduous manual labour, members were taken "below stairs," where they were able to inspect another invention of Mr. Gill's which, besides advantages of economy, possesses perhaps even greater claims to consideration on the score of being a hard-labour saver. This was his furnace-clinkering machine. When the Association last March visited the Stepney works of the Commercial Gas Company, they saw at work one of these machines actuated by compressed air, and were assured that during the time it had been in operation it had given every satisfaction. In the issue of the "Journal" which recorded the visit to Stepney, there appeared [on p. 721 of the number for March 17, 1914] an illustrated description of the invention; and it was there stated that a machine actuated by hydraulic power had been in operation with very good results at Wapping for a period of about fifteen months. This machine was at work on Saturday, and the visitors watched it dealing in an eminently businesslike manner with a particularly obstinate mass of clinker. It was a severe test for the machine, which naturally took longer to clear the furnace than is the case when it is dealing with more amenable material. It could be seen that this method of clinkering demands no special skill from the operator; and the machine is absolutely under control, both as to length of travel and direction of stroke. It is a rule to do the clinkering every 24 hours; and a man does eight furnaces a day. It was stated by Mr. Gill that in future the clinkering tool of these machines will be provided with a chisel-head (moveable so as to be in the horizontal or vertical position), which will be the best form for attacking the clinker. The machines can be used with compressed air, hydraulic power, or steam; but compressed air is considered to have an advantage over hydraulic power, inasmuch as by its aid one can get a much better blow delivered.

In the smaller retort-house, there are nine generator settings of seven through retorts operated by a combined De Brouwer projector and pusher. Some of these settings are at the moment being reset with retorts of oval section—21 in. by 18 in. They are, of course, nearly round; and it is thought they will keep their shape better and have other advantages over the ordinary Ω type. The sections fit one into another; the ends being rebated, which makes a better joint. Each through retort is in three sections—a 10-foot one in the centre, with a 5-foot one at either end. Thus if a joint goes it will be easy to get at it for repairs. Some of the retorts in this house were seen discharged, and the large size of the coke (which, for one thing, has practically no fall to break it) was remarked upon. There is no room for storing at Wapping; and coke is taken away by vans almost as soon as it is made. Twelve-hour charges are worked; and the coal used is a mixture of Durham kinds.

A very interesting feature of the works is the provision for the unloading of coal, which is brought alongside the jetty on the Thames in the Company's steamers. The unloading of the ships is carried out by three hydraulic cranes, fitted with one-ton Williams grabs. A collier of 1100 tons capacity comes up about three times a fortnight; and it is necessary to discharge it in twelve hours—that is, within one tide. The plant is therefore of a capacity of rather over 100 tons an hour. At the top of the jetty hopper, under each grab, there is a gas-engine driven breaker, so that the coal is broken directly it is taken from the ship. It then falls down a shoot on to a belt conveyor, 350 yards long, consisting of a curved band 30 inches wide, in two lengths, which takes it to the store. It is not possible at present to take 1000 tons at a time, so that when unloading a ship a small quantity of the coal has to be put back into barges and dealt with subsequently. The colliers run on coke; and there is provision on the jetty for tipping coke into the ships' bunkers. This type of belt conveyor for the coal is found to be most satisfactory; and the belt, so far as Mr. Gill can judge, will last five or six years. The running cost, too, is low. A 36-H.P. gas-engine drives the conveyor, which moves over 100 tons of coal an hour on a very considerable gradient. From the first conveyor, the coal drops into an automatic weighing machine, which holds 30 cwt. When this amount is on the machine, the top door shuts, and a bottom one opens, and then the machine fills up again. There is recorded on a dial exactly the weight of coal which passes over. The coal then drops on to the second length of belt, which carries it to the overhead storage hopper. Coal is unloaded at this works for the Stepney works, which are supplied by means of steam-waggons. At present these waggons are loaded in the street, by a shoot in the wall of the coal-store. This arrangement is, however, now being improved upon. Beneath a store which is to hold 1000 tons, a tunnel will be made, into which the steam-waggons will run; and here they will be filled from shoots above them.

In connection with the purification of the coal gas, there are no tar-extractors or washers; but only the tower-scrubbers. The gas goes through the whole series of five tower-scrubbers, the last but one of which is a special small tower, in which oil-gas tar is used for extracting the naphthalene from the gas. In the last scrubber boards are used; the others being filled with coke. They get all the ammonia out, and throw no back-pressure. Very strong liquor is obtained throughout the works, both in the retort-houses and scrubbers. It is sent away at about 12 oz. strength in barges to the Poplar works to be dealt with.

There are also for the coal gas a set of five luteless oxide purifiers, 40 ft. by 28 ft. by 8 ft. in depth. These are worked on the backward rotation system. All five are in series; and when a change has to be made the last one is put first. There are "Hurdle" grids in two, and ordinary grids in the other three. Burnt oxide solely is used, and does its work very well. Indeed, no new oxide has been bought for the works in the past six years. There is a floor above the purifiers, where the oxide is mixed up, turned, and watered. Over each purifier there are four openings, and canvas shoots can be moved from one to another as wanted. In discharging, one-half of the contents of the purifier is elevated to the upper floor in small trucks lifted by an electric winch.

The other half falls through openings on to the ground below. Oxide is taken in trucks from the bottom to the top of the house by a hydraulic lift. The electric winch is found to answer its purpose very well indeed. As the oxide comes out of the purifier, a good deal of it is hard; and to deal with this, there is a small crusher which breaks it up. This is of a capacity of 8-tons per hour, and is also driven by an electric motor—the power, of course, being generated on the works.

At the close of the visit, the members were entertained at tea in the billiard-room on the works, and afterwards,

The PRESIDENT remarked that those of them who were among the party that visited the Stepney works of the Commercial Gas Company last March would remember that Mr. Gill then said it would be a pleasure to him to see the members at the Wapping works. This visit also was now an accomplished fact; and they would agree that a very instructive afternoon had been spent in going round the works. The Company were placed in a somewhat unique position, in that they were closely ringed-round by the districts of other companies. In other words, there was no room for expansion. But where the Company had enlarged their field of usefulness was in the supply of gas to consumers for industrial purposes. They were continually making fresh efforts to serve those people who wished to use gas in this way. The works had proved that, however difficult it might be for the gas industry to assert itself, it generally came out on top. In walking round it could be seen that there was hardly room to put any additional plant down, and yet everything worked well. The breaking of the coal at the very first opportunity was a lesson which might be taken to heart at other places, for it seemed the correct thing. The clinkering machine they had seen at work was an ingenious device, which obviated what was clearly a very hard form of manual labour. An unusual feature of the works was the fact that, owing to the peculiar circumstances in which they were situated, some of the gas manufactured there was sent away to be purified and further treated at another station of the Company. He proposed a hearty vote of thanks to Mr. Gill and those assistants who had conducted them round, and also to Mrs. Gill for presiding at tea.

Mr. F. J. PEARCE, in seconding, referred to the very small area of ground on which the works stand—some 3½ acres. He also remarked on the ingenuity displayed in adapting to gas-works purposes buildings which already existed on additional pieces of land when acquired. An example of this was the hydraulic engine-house, which was originally in use as a mill.

The vote was cordially passed, and

Mr. GILL, in response, assured the members that it had been a very great pleasure to show them round, and on behalf of Mr. Williams, Mr. Goddard, Mr. Cook, the ladies who had dispensed tea, and himself, he thanked them for their vote. The Wapping works, he said, were very old. In fact, some parts of them had been in existence for quite a hundred years. Previously they were the works of the Ratcliff Company, who amalgamated with the Commercial Company in 1875. Before that they belonged to the East London Gas Company, which dated back to the very early days of gas lighting. The works might be old, but they were quite up to date in the matter of results, and some fairly big figures were realized with them. They looked to get something in the neighbourhood of 15,000 cubic feet of gas per ton of coal, and to sell, in addition to breeze, 11½ cwt. of coke. At the same time, it was done quite cheaply; and this was due to some extent to the congested nature of the works. They were able to transport materials at a very low cost. This applied particularly to the coal, which, as they had seen, was handled in a very economical manner. There was nothing in the way of ornamentation about the works. The endeavour had been to spend the money so that it should all be dividend-earning, without any allowance for show or decoration. This was the policy of the Commercial Gas Company; and it seemed to him to be the right one.

WORKS TOPICS.

By "Modus Operandi."

AIR LEAKS IN RETORT-HOUSES.

SOME precautionary measure to prevent the accidental admission of air into coal-gas plant on the inlet side of the exhauster should always be taken at periodical intervals. Frequently it will be found that some joint or plug-hole has unwittingly been allowed to leak, with the result that air has been admitted, and the "pull" on the gas has had to be reduced—slightly it may be, and therefore unnoticed. But yet in such cases the loss is a real one; for a check has been put on the passage of good gas to compensate for the admission of air. The loss is much greater than the gain, if "gain" it may be termed. To carry out such a test, it is only necessary to put the retort-house and other plant previous to the exhauster under a slight pressure during the Sunday stop. A careful examination will then quickly disclose leaks, which would be extremely difficult to locate were the plant at work.

SEASONAL PRECAUTIONS.

Now is the time of year when gasholder cuppings, gas-engine jackets, and hydraulic and other water pipes are liable to be frozen at most unexpected times; and it behoves all engineers to take the necessary steps to ensure against such risks. A few minutes devoted to matters of this kind is time well spent, and will save many an unfortunate occurrence. Small boilers, which are sometimes provided for steaming the cuppings of holders, are very liable to rust badly while at rest, unless proper precautions are taken. A lighted gas-jet is very effectual in preventing the freezing of hydraulic crane cylinders and gas-engine jackets. A better plan is to run off the water (for which provision should be made) when the work for the day is finished. But this cannot always be done.

WORKMEN'S LOBBIES.

No excuse can be made for the gas-works which fails to provide decent workmen's lobbies, where the men can wash and change in comfort, and cook and eat their food. Provision of this sort should be arranged whereby washing and changing are done in one room, and cooking and eating of food in another. In each room, lockers—which are best made in sheet metal—should be provided of a suitable size, in the one case for clothes and in the other for food, for each individual man. In the washing and changing room, a gas-heated water circulator and a large hot-water tank should be fitted to supply the basins and baths. The basins should be trough-shaped, and of very large size; and they can conveniently be placed back to back in a range. Several galvanized hip-baths should be provided, and also sprays fitted on flexible tubing. The floor should be tiled throughout, with a good slope to the drain. The room should be heated by hot-water pipes—preferably by a gas-heated greenhouse or garage boiler—as by this means the pipes can conveniently be used for drying wet clothes. In the mess-room, the lockers for the men's food can be quite small, or alternatively a large cupboard can be used. A suitable size of gas-cooking range, together with forms and tables, and gas-radiators to heat the room complete the furnishing requirements. Such accommodation should be considered a necessity; and there is no doubt where it is provided a complete *quid pro quo* is obtained in better and more willing service.

SAMPLE ROOM.

The manager who wishes to keep up-to-date must perforce spend a portion of his time in being interviewed by the host of commercial travellers who seek his custom. No one can afford to overlook the many excellent articles and materials which are introduced in this way, though in sorting out the "grain" from the "chaff" much time is wasted. Some considerable amount of time can be saved by adopting the plan of establishing a "Sample Room," where every article used is deposited and is labelled with particulars as to description, approximate yearly quantity used, price, &c. Many an interview can be cut short by having at one's disposal just the information that is usually required, without the necessity for sending for the storekeeper or foreman.

EVENT AND COMMENT.

[COMMUNICATED.]

THE QUALITY OF SULPHATE OF AMMONIA.

THE address of Mr. D. Milne Watson, before the Sulphate of Ammonia Association, on the subject of the quality of sulphate of ammonia for export comes as a timely comment on the work of those who are pressing for fuller recognition of the scientific side of bye-product recovery in connection with the carbonization of coal. It also serves as another instance of the commercial adaptability of the Germans in laying themselves out to make the supply come up to the standard of the demand. Too often the policy of the manufacturer in this country has been just the opposite, and he has tried to make the buyer accept the standard which the seller has set up, with ultimately disastrous results. Since the introduction of bye-product recovery in connection with coke-ovens, and more particularly since about 1905, when direct-recovery processes were introduced, the production of sulphate of ammonia has increased enormously, and by far the major portion of this increase is due to the coke-ovens.

Now bye-product recovery on coke-ovens has developed along very scientific lines, and a great deal of attention has been paid to the production of pure products. The production of a high grade of sulphate of ammonia containing at least 25 per cent. of ammonia, less than 2 per cent. of moisture, and less than 0·5 per cent. of free acid, is a comparatively simple matter on modern coke-oven plant. Almost every coke-oven plant uses a centrifugal drying machine for drying the sulphate as it comes from the saturator. In this machine the salt is washed with hot water, and so the free acid can be almost entirely eliminated. After washing and partially drying, the salt is removed to a well-situated store where it can undergo further drying; the store in some cases being steam-heated. The whole of the ammonia recovery plant on a modern installation of coke-ovens is under chemical control; and hence the quality of the salt can be regulated to a nicety. The Germans have established the practice of making a salt containing at least 25 per cent. of ammonia. After a time, even an unscientific buyer—and this class is rapidly dying out—comes to see that it is a bit foolish for him to pay £11 or £12 per ton for sulphuric acid costing only £2 and for water which he can get for nothing. Consequently, we can only expect that the requirement with regard to quality will eventually become even more stringent than it is now.

EFFECTS OF THE WAR.

Coke-oven proprietors, and also gas engineers, are learning many valuable lessons as a result of the war; and at the conclusion of the latter, we must expect many radical changes to be brought about. There has been in the past a great deal of

dependence on outside sources both for the purchase of the raw materials and also for the sale of products, which, in the writer's opinion, has been inimical to progress as far as new ideas and processes are concerned, and has also been the direct cause of loss to the parties concerned. The writer has referred in previous notes to the trouble experienced at some works in getting rid of products, especially liquid products, such as tar and ammoniacal liquor. The storage of these liquids is something of a problem even at the best of times, for a liquid needs a tank, and large tanks which will allow of the storage of considerable quantities are expensive. Solid products, on the other hand, can be stored almost anywhere, in either large or small quantities, and stocks can be moved at will according to the exigencies of the situation. Very soon after the outbreak of war, some tar distillers found it necessary to issue a warning that they might be unable to take delivery of the tar contracted for, and the same was the case with ammoniacal liquor. Then at a later date came the arrangement that the distiller was only to pay an agreed figure for the value of the liquid products from the tar, the pitch standing over until it could be sold; the distiller paying *pro ratâ* according to the sales. Such an arrangement is, of course, fair up to a certain point, as it shares between the producer and the distiller the burden of diminished trade. But it is the producer who has all the worry of arranging about storage, and who has to stand the loss should his storage be insufficient; hence he is compelled to waste or otherwise dispose of his products.

Reference has been made in this column to the increasing tendency on the part of the producer—both at gas-works and coke-oven plants—to go a stage further in the working-up of his own products. In the writer's opinion one result of the war will be a still further development in this direction. More sulphate will be made on the works, instead of liquor being sold to distillers; and incidentally the writer believes that direct recovery will receive much needed attention from gas engineers. Tar plants will also be erected, and producers will distil their own tar. Several such plants have been erected during the past year, and there are at the present time numerous tar distillation plants under erection both at gas-works and coke-ovens. If the tar distiller can sell the liquid products of distillation, the producer who distils his own tar ought to be able to do so as well, and, moreover, he should be able to save the profit which the large distiller has to make for his share in the transaction. Then if he has to store the pitch, he is no worse off than he is when the large distiller stores it and only pays when it is sold. With regard to storage, he must, of course, provide a reasonable margin of storage for the liquid products of the tar distillation. He has also to store the pitch.

Sulphuric Acid Production.

Some difficulty has been experienced lately in certain quarters in obtaining supplies of sulphuric acid for sulphate plants; and the writer has heard of two or three cases where acid has been unobtainable, and much loss of ammonia has taken place. Prices are also very much on the high side. It is, of course, a big undertaking to put down a sulphuric acid plant, especially as the raw material—sulphur or pyrites—frequently comes from abroad. But the writer gathers that there is a feeling, where the size of the plant warrants it, that an acid plant should be put down. [This is a subject dealt with in the editorial columns on Nov. 17.] On gas-works, of course, the spent oxide would furnish a proportion of the sulphur required. Very few coke-oven plants purify their gas from sulphur at present. There is, however, an increasing tendency to do so on account of the fact that gas-engines are being installed in many cases to use the surplus gas, and in such instances it is desirable to remove the sulphur. The writer would, therefore, sum up the position by saying that the result of the war will be to make as far as possible coke-ovens and gas-works independent of external sources for raw materials, and also to develop further the bye-product processes, in order to do away with the large tar and ammonia distillers.

The Corrosion of Firebricks.

The writer has made further inquiries into the opinions held by various people on this subject, and can find no unanimity. Partisans can be found supporting the writer's opinion that silica bricks stand corrosion best, but no further case based on actual experience has come to light. On the other hand, various coke-oven managers have spoken in favour of the alumina bricks; but, unfortunately, not one of those consulted has actual experience of salty coal. The subject is an important one and worthy of attention; hence much interest attaches to the following statement which appears in the "Journal of the Iron and Steel Institute Abstracts:"

O. Simmersbach [Stahl und Eisen, 1913, pp. 2120 2121] draws attention to the fact that while the disintegration of the coke-oven walls is due in part to the decomposition of hydrocarbons and deposition of carbon in the pores of the bricks, the same kind of action may be caused by volatile carbonyls of iron such as $Fe(CO)_5$. In support of this, analyses are given of the different layers of a brick used in a furnace, and attention is drawn to the gradual rise in the iron content of the same from the bottom upwards.

This explanation is a novel one, and who can say that it is not a true one? An interesting communication—and one supporting the writer's original opinion—is to hand from a brick maker. He gives the information that in kilns used for glazing bricks, where enormous quantities of salt are volatilized, silica bricks last much longer than alumina bricks.

INDUSTRIAL GAS CALORIMETRY.

THE BOYS CALORIMETER.

By E. F. Mueller, of Washington, U.S.A.

In a communication by Messrs. C. W. Waidner and E. F. Mueller ["Journal," April 14, p. 101], it was shown that a Boys calorimeter—Griffin's make, No. 67, tested at the Bureau of Standards—was subject to very considerable heat losses amounting to about 2 per cent. of the heat supplied by the combustion of the gas, and that therefore heating values as determined with this calorimeter were about 2 per cent. low. In an editorial notice in the "Journal" for April 14, p. 89, the question was raised as to whether the result obtained was due to a defect in the Boys calorimeter used, or whether all calorimeters of this type would give low results.

While the previous experiments had left little room for doubt that the heat losses were due to the design, and would therefore be found to a greater or less extent in all calorimeters of this type, it seemed desirable to supplement the previous data with experiments on other calorimeters. Through the courtesy of Mr. J. B. Klumpp, the Chairman of the Committee on Calorimetry of the American Gas Institute, the Bureau was able to secure the calorimeter (Griffin's make, No. 60) that had been used by the Committee in their experiments in 1907-08. Mr. W. R. Addicks, of the New York Consolidated Gas Company, also placed at our disposal two Boys calorimeters, one of the usual type (Griffin's make, No. 84) and another (make unknown) of somewhat different design. The latter calorimeter will probably be of little interest to users of the official instrument; and it will be sufficient to state here that it gave about the same results as Nos. 67 and 84.

The Boys calorimeters were modified by punching a small dimple on each side of the condensed products spout, as directed in the more recent notifications of the Metropolitan Gas Referees. Otherwise the calorimeters were used without modification, except that the products thermometer was suspended in one of the large holes in the top of the calorimeter, so as to permit circulation of the products past the bulb. The radiator coils were reasonably clean, and were free from deposits of soot. Two of the calorimeters, Nos. 67 and 84, still have maker's seal intact.

Necessary repairs were made to the Boys calorimeter, No. 60, to eliminate leaks in the water circulation system. All calorimeters were tested for leakage of water. Tests for gas leaks, by shutting-off the gas at the burner cock, were regularly made as part of the routine of testing. One calorimeter (No. 67) was also tested for gas leaks by plugging the burner-tips; and the whole system was found to be free from leaks. New burners were, of course, used in subsequent experiments.

The experiments were carried out as follows: The inlet water was maintained at the room temperature by a thermostat. A sample of gas was collected in a 5 cubic feet gasholder. The calorimeter to be used was brought to equilibrium with gas drawn from the supply pipes. When the test was to be made, a three-way stop-cock, suitably connected, served to substitute the gas from the holder (through a separate meter) for the gas from the supply pipes. Two tests could thus be made with about 1 cubic foot of gas from the holder. After the completion of these tests, another calorimeter was substituted; the same thermometers being used and the test made as before. The last test with a tankful of gas was always made under conditions as nearly as possible identical with those prevailing during the first test; so that if any change in the character of the gas in the holder had taken place, the change would be shown by the tests.

In calculating the results of tests the observed heating value, as previously defined [*loc. cit.*], was first computed. The total heating value was then found, for the results obtained with the Junkers calorimeter, by applying the correction for heat loss (one B.Th.U.) and the correction for the effect of atmospheric humidity [see Table XIX., as given in the "Journal" for April 14, p. 103]. The correction for atmospheric humidity effects was also applied to the heating values obtained with the Boys calorimeter.

There is abundant justification for designating the value found with the Junkers calorimeter as the total heating value of the gas, for at least two reasons: (1) The experiments with the bomb calorimeter which have now been concluded show that the Junkers calorimeter and the bomb calorimeter give results in satisfactory agreement. (2) The Junkers calorimeter has given results agreeing within 0·2 or 0·3 per cent. with those obtained with the Hinman-Junkers, Sargent, Simmance-Abady, and Parr calorimeters, and differing only from those obtained with the Boys calorimeter. The data obtained are summarized in Table I.

Practically complete data of the tests of Aug. 19, 1914 (all of which were made with one holder full of gas) are given in Table II. All the calorimeters were operated at their normal rates of gas consumption. It will be observed that in the computation the Referees' correction for the difference between air temperature and products temperature has not been applied, but the correction for the effect of atmospheric humidity has been applied. This procedure is permissible, as analysis of the products had shown that the ratio of volume air/gas was about 7 : 1; so that the corrections of Table XIX. were applicable. The correction for heat loss has not been applied in calculating the results for the Boys calorimeters, although such corrections might have been taken from the results given in Table I.

TABLE I.—*Tests of Boys Calorimeters.*

Date.	Net Heating Value.			Total Heating Value.		
	Junkers No. 1209.	Boys.	Difference Per Cent. of Net.	Junkers No. 1209.	Boys.	Difference Per Cent. of Total.
Boys Calorimeter No. 67.						
Aug. 1, 1912	602	589	2·2	662	650	1·8
Sept. 3, 1913	580	577	0·5	628	616	1·9
Feb. 21, 1914	621	607	2·3	665	651	2·1
May 11, 1914	618	620	−0·3	671	658	1·9
Aug. 19, 1914	636	—	—	694	682	1·7
						Aver. 1·9
Boys Calorimeter No. 60.						
May 9, 1914	605	601	0·6	658	650	1·2
May 11, 1914	618	626	−1·3	671	663	1·2
Aug. 19, 1914	636	632	0·6	694	685	1·3
						Aver. 1·2
Boys Calorimeter No. 84.						
Aug. 14, 1914	640	—	—	697	684	1·9
Aug. 19, 1914	636	—	—	694	677	2·4
						Aver. 2·2

These results indicate that the low observed heating values obtained with the Boys calorimeter are in part due to the smaller amount of water vapour condensed in the instrument, and that the net heating values obtained would be more nearly correct than the total heating values. Measurements of the saturation temperature of the products, however, indicated that these were saturated at about the inlet water temperature. The evidence is, therefore, somewhat contradictory. It is evident, however, that conclusions based upon the net heating values obtained with the Boys calorimeter are subject to considerable errors.

HEAT LOSSES.

In operating Boys calorimeter No. 67, heat was supplied at the rate of about 8000 calories per minute. Tests given in Table I. indicate a heat loss of about 2 per cent.—*i.e.*, 160 calories per minute. The temperatures of various parts of the cylindrical metal surface were measured by the surface thermocouple previously described. It was found that the lower part of the cylindrical surface was about 4·7° C. warmer than the inlet water (and room); while the top was about 2·5° C. warmer. The outer edge of the metal plate on the base of the calorimeter was, however about 17° C. warmer; while the temperature at about 5 cm. from the edge (and therefore in a part not directly exposed to the radiation from the burners) was about 23° C. above that of the inlet water. It is difficult to estimate just how much heat would be lost from this plate, since it is insulated by the wooden base. It was noted that the lower surface of the wooden base, which is over 5 cm. thick, became appreciably warm when the calorimeter had been for some time in operation.

The loss from the cylindrical metal surface was calculated as follows: The heat loss from a similar nickel-plated surface was found to be about 0·006 calorie per minute per square centimetre of surface per degree Centigrade difference between surface temperature and room temperature. The area of the cylindrical metal surface of the calorimeter is about 1500 square cm. Therefore, the heat loss from the surface was about 1500 × 0·006 × 3·6 = 32 calories per minute.

The combined losses from the cylindrical surface and from the bottom may evidently be as large as 100 calories per minute. If in addition we consider the heat losses from the top, the sensible heat loss in the products, the sensible heat loss in the condensed water (which is warmer than the inlet water), &c., it is evident that a heat loss of an order of magnitude of 100 to 150 calories per minute is readily accounted for; and the fact that the calorimeter gave results about 2 per cent. low is accounted for by these various heat losses.

The fact that Boys calorimeter No. 60 gives higher results than the other two is probably in part accounted for by the fact that its normal rate is higher, and the heat losses may therefore be a smaller proportion of the energy supplied; and also by the fact that the heat losses are probably somewhat smaller because more of the radiator coils are immersed in the stagnant water in the bottom of the calorimeter. There are about ten turns of radiator coil in No. 60; about nine and three-quarter turns in No. 84; and only nine and a half turns in No. 67.

TABLE II.—*Tests of Junkers and Boys Calorimeters, Aug. 19, 1914.*

Experiment No.	Calorimeter.	Room Temperature.	Humidity per Cent.	Products Temperature.	Rate of Gas Consumption. Cu. Ft. per Hour.	Temperature of Inlet Water.	Corrected Temperature Rise of Water.	Weight of Water Heated. Lbs.	Volume of Gas Burned Reduced to 60°F., 30 in.	Observed Heating Value.	Correction for Heat Loss. B.Th.U.	Correction for Atmospheric Humidity.	Total Heating Value.	Condensate per Cu. Ft. (60°, 30 in.) c.c.	Net Heating Value.
1	J1209	86·2	50	86·6	5·5	86·43	17·86	7·132	0·1848	689	+ 1	+ 4	694	22·9	637
2	,,						17·86	7·137	0·1848	690			695		
3	B60	87·1	49	92·5	4·1	86·43	23·44	5·344	0·1842	680	?	+ 5	685	20·7	632
4	,,						23·44	5·344	0·1892	680			685		
5	B67	89·6	46	93·2	3·2	89·27	15·97	7·745	0·1829	676	?	+ 6	682	11·3	?
6	,,						15·95	7·767	0·1829	677			683		
7	B84	90·5	47	95·0	2·9	91 07	14·92	8·190	0·1820	671	?	+ 6	677	none	?
8	,,						14·92	8·188	0·1820	671			677		
9	J1209	90·7	50	90·7	5·6	90·53	15·21	8·208	0·1818	687	+ 1	+ 5	693	22·5	635
10	,,						15·25	8·174	0·1818	686			692		

TABLE III.—*Number of Cubic Centimetres of Condensate Collected per Cubic Foot (at 60° Fahr., 30 inches Bar.) of Gas Burned.*

[Each result was computed from the amount collected during an interval of about ten minutes.]

May 12, 1914.		May 13, 1914.	
Junkers No. 1209.	Boys No. 67.	Junkers No. 1209.	Boys No. 60.
22·3	25·4	22·4	21 2
22·3	27·1	22·9	21·7
22·0	27 1	22 3	20·8
22·0	8·6	22·8	21·7
21·8	19·3	22·6	21·1
22·2	20·0	22 3	21·6
21·9	19·3	22·8	22·0
—	—	22·5	21·9
Average 22·1	21·1	22·6	21·5

NET HEATING VALUES.

It will be observed that the results obtained for net heating values are extremely erratic. This is due to the fact that the drainage of condensate from the Boys calorimeter is apt to be irregular. In the experiments cited, it was not possible, on account of the limited capacity of the gasholder, to collect the condensate formed during a long period of operation, which would have been necessary in order to obtain dependable results for net heating values with the Boys calorimeters used. A special series of experiments was, therefore, arranged to determine the relative amounts of condensate delivered by the Junkers and Boys calorimeters. The calorimeters were operated simultaneously; and the total amount of condensate collected during a period of about one hour was measured. To secure information as to the regularity with which the condensate was delivered, the amounts collected during intervals of about ten minutes were measured separately—taking care, however, to make the measurements in such a way that the total amount delivered by each calorimeter during the entire time could be found. Calorimeter No. 84 was not included in these tests, because its products' spout was so shaped that the condensate was discharged, periodically, at intervals of one or two hours. Results are given in Table III.

SUMMARY.

The data presented in this paper show that the heat losses from various Boys calorimeters amount to from 1 to 2 per cent. of the heat furnished by the combustion of the gas when supplied at the normal rate. If the Boys calorimeter is to be used for the determination of the total heating values to an accuracy better than 2 per cent., it appears that each instrument should be tested to determine its heat loss. The most practicable method of determining such heat losses would be by comparison with a calorimeter substantially free from such losses. If this is done, calorimeters of the Boys type may be used as secondary instruments, and accurate results be obtained if the corrections for heat loss, &c., are applied. The Boys calorimeters tested were not adapted to the determination of net heating values.

LIGHTING DURING WAR TIME.

Some Lessons to be Learned from the Present Lighting of London.

There was an interesting discussion last Tuesday evening at a meeting of the Illuminating Engineering Society, at the Royal Society of Arts, on the subject of "Illuminating Engineering in War Time." Mr. F. W. GOODENOUGH (the Chairman of the Council) presided; and Mr. LEON GASTER introduced the subject for consideration.

THE PART OF LIGHT IN WAR.

In his opening remarks,
Mr. GASTER observed that the war is having, and would have, a profound effect on the lighting industry. The object he had in initiating the discussion was to point out how some aspects of the present situation affected the illuminating engineering movement, and to consider what service the Illuminating Engineering Society could render to the lighting industry as well as to the nation at the present time. Light is playing a conspicuous part in the war. Searchlights are being widely used at sea and in the air. Flare lights are being employed to enable trench digging to proceed at night time. Various forms of portable illuminants—acetylene, oil, &c.—have been employed in connection with transport and hospital work. Light has also been the means of preserving life by facilitating the search for the wounded, and by making possible operations in the hospital tent. There is, too, the lighting of many camps and barracks for the housing of Lord Kitchener's new army; and the lighting of these in remote districts is quite a special problem. There is also the lighting of rifle-ranges. Upon these various points, Mr. Gaster dilated.

LIGHTING OF STREETS AND OPEN SPACES.

Proceeding next to the consideration of the lighting of London streets and other localities during war time, as a precaution against possible air-raids, Mr. Gaster said that loyally the regulations and the conditions are accepted; but the methods adopted to comply with the regulations are interesting matters.

In some cases the authorities have contented themselves with simply turning out the majority of the lights; in others special forms of lamps have been installed—*e.g.*, in some streets the flame arc lamps have been replaced by glow lamps with opaque shades, completely screening the lights, and directing the illumination on the roadway.

The methods practised are broadly divisible into two classes: (*a*) diminishing the power and the number of the lamps; (*b*) covering the lamp-globes with obscuring bands so as to block-out the rays above, and restrict the illumination below. It is obvious that various combinations of these methods might be used to give the same result, as far as the essential object of the changes is concerned, but might at the same time be widely different in their results from the illuminating engineering standpoint. For example, the width of the obscuring band has a very material effect on the illumination of the roadway. To the uninitiated it would appear that in some cases the amount of obscuration is unduly high, and the merging cone of light very restricted; also that the area illuminated is very much less in some cases than in others. Naturally the practice in this respect will vary, according to the importance of the locality and the nature of the street.

A point for wonder on the part of Mr. Gaster was as to whether any member of the Society has had the curiosity to attempt to measure the illumination in some of the main streets in the dark areas between the lamps. It must be exceedingly low in comparison with that prevailing in normal times. It would be a pity if the opportunity were not utilized to take a record of these highly unusual lighting conditions. He has recently applied for a permit to take an extensive series of measurements and photographs. Without such a permit, it would not be desirable to attempt the feat at the present time.

According to the most recent regulations, permission may be given to turn on the lights to their normal value in case of a fog. As matters stand, it would hardly be possible to do so in many cases, owing to the obscuring of the lamp-globes. This points to the desirability of having alternative methods of lighting—*e.g.*, some lamps unscreened, which are unlighted under ordinary conditions but could be turned on in a fog; or small candle-power glow-lamps as adjuncts to the arc lights, and used instead of them (as is done even under normal conditions in some streets late at night). Recalled by Mr. Gaster were several cases of public streets lighted by incandescent electric lamps, a considerable proportion of which have been completely removed. Needless to say, in case of fog there would be some trouble in bringing the light back to its normal condition, since it would be necessary to send men round to replace the lamps that have been taken away.

Speaking generally, the chief point of interest to the lighting engineer is, "How far is it necessary to diminish the total amount of light; and how far is it possible to meet the required conditions merely by redirecting the rays?" Public safety, of course, comes first. But granted this, the minimum inconvenience would naturally be caused by the latter method. An observation of the present conditions leads one to suppose that it might be possible, without detriment to the authorities' wishes, to aim at greater uniformity of illumination, at least in less important streets, and less "spottiness." Besides making specific regulations as to the number of lamps to be turned on in certain streets, it might be useful to specify that the unobscured rays should be included within a certain prescribed maximum angle. The greater the permissible angle the less, of course, the inevitable spottiness.

In the discussion of Mr. Trotter's paper on the "Street Lighting Specification" last year, the relative advantages of a uniform moderate illumination, and an arrangement providing for brighter illumination at points, with lower values in between, was discussed. Now before us is an example of conditions which would never be encountered in normal times—viz., very patchy lighting with an exceedingly low minimum. What conclusions can be drawn from experience? It will be generally agreed that the extreme contrast between the comparatively brightly lighted regions and those in obscurity is a drawback, particularly as regards guidance of traffic, and that present experience confirms the desirability of fairly even illumination.

TRADE AND LIGHTING.

However, taking the conditions as they are, what is the effect of the diminished lighting? There is now a state of things in the streets of London such as probably has not existed in the last fifty years, and which it may be trusted we shall never see again. It would, therefore, be worth while to keep a record of their influence on the public mind and on the transaction of business generally. One finds a fairly general impression that the absence of light has a certain depressing effect, and that it tends to keep people indoors at night—checking the patronage of entertainments and evening shopping. The opportunity should be taken to make the interior of the house as cheerful as possible, and to see that the lighting is satisfactory and up-to-date. Let it be hoped that activity in this direction will partially counteract the diminution in lighting out of doors.

DIMINISHED LIGHTING AND TRAFFIC.

This leads to another important point—the effect of diminution of light on traffic and in causing possible accidents. Here it would be most useful for future guidance if a careful record of accidents in the streets could be kept. The available data are somewhat difficult to interpret. In some quarters it has been declared that the number of street casualties has considerably increased since the regulations came into force. On the other hand, the most recent official announcement suggests that this is not the case (although the fact that stress is laid on the desirability of special care on the part of motorists shows that the danger is recognized). But it may be pointed out that, simultaneously with the change in the light, the volume and probably also the speed of the traffic, and also the number of people using the roadway, have enormously diminished. Moreover, it is obvious that by taking special care in crossing streets, &c., people can avoid to a great extent accidents which would certainly occur if they went about their business in the ordinary manner. Therefore it should not be too readily assumed that the diminished lighting has had no effect, and could be permitted in normal times. There must be a limit in the reduction of illumination below which even great care would not avoid mishaps; and it is a question whether we are not nearing this limit at the present moment.

A reference to dazzling head-lights on motor cars led Mr. Gaster to remark that it has often been urged that the glare from modern street-lamps is a decided drawback, and that a much better visual effect would be obtained if these were screened from the eye. It has also been suggested that the glare from modern powerful street-lamps has sometimes been responsible for accidents, just in the same way as the dazzling effect of motor-car head-lights is apt to be. Possibly the present conditions may reconcile the public (which has hitherto obstinately clung to the tradition of glare) to in future a milder method of illumination, and that screening with some form of translucent reflector may meet with approval. In order to avoid offending the eye, it would not, of course, be necessary to screen the lamps anything like so completely as at present, and provision could be made for sufficient light to pass upwards and sideways so as to illuminate the buildings at the sides of the street. A characteristic of the temporary method of lighting now in use is that practically *all* the available light is directed on the roadway and pavement. From an æsthetic standpoint, it will be agreed that the method is not a success.

SHOP LIGHTING AND CONCEALED LAMPS.

With a passing reference to the lighting of public vehicles, Mr. Gaster got on to the subject of the lighting of shops. The chief point of interest is that the recent regulations are driving entirely in the direction advocated by the Society for other reasons. It has been consistently pointed out that the finest effects in shop-window lighting are to be achieved by treating the window like a stage, where the brightly illuminated objects are made the chief points of interest and the lights themselves are concealed. A merchant who relied entirely on this principle of concealed lighting would not now find himself obliged to alter the lighting of his windows to any great extent. The merchant who has relied on exceedingly bright lamps placed in the window now suffers for his neglect of the principles of illuminating engineering. The authorities have required that such lights should be screened, and also that powerful lamps outside the shops should be covered by screens which hide the lamps from view and prevent any large amount of light falling on the pavement. In this respect they are

merely carrying further the practice in the City of London, where there has been for some time a regulation that such lamps should be screened on the side facing the roadway. Naturally the present regulations have had the effect of practically eliminating what is known as "parade lighting." In some cases the lamps employed for parade lighting are so powerful that some means of softening the light might be encouraged even in times of peace. But the chief thing to be guarded against, to Mr. Gaster's mind, is the sudden change from a comparatively low illumination to a brilliantly lighted area. Such abrupt changes might be avoided by "grading the lighting"—*i.e.*, by using lamps of progressively increasing candle power, so that the change in illumination is not so sudden.

A walk round any of the streets of London just now reveals an extraordinary diversity in the appearance of shops, and in the means adopted to comply with the police regulations. Almost invariably the outside lamps are extinguished. Lamps in the window are swathed in varied degrees of opacity and colour. In some instances the fact that the bare lamp-bulbs have been tinted blue is apparently accepted as complying with the requirements of the authorities. Needless to say, these amateur efforts result in very indifferent window lighting; and it may safely be said that in most cases it would pay the merchant to adopt concealed lighting in preference. It is to be noted that various firms have rightly taken the opportunity to urge the advisability of methods of this kind; and at the present moment there should be a demand for such methods of conversion.

It is quite obvious that the problem of deciding when and how lights should be diminished is an exceedingly difficult one for the ordinary police constable to determine; and it seems reasonable to suppose that the help of some members of our Society, who are accustomed to dealing with problems of this kind, would be of value to the authorities. It would perhaps be desirable to have a rough standard of permissible intrinsic brilliancy. Concealed methods of lighting should surely be encouraged. If, in addition, some limit to the illumination is necessary in order to avoid undue lighting of the pavement, it should not be very difficult to frame an additional recommendation on this point for the guidance of contractors. If there is to be any penalty for non-compliance with official recommendations, the consumer and the contractor should be given definite information as to what is permissible, and what is not.

Following were comments on the suppression of street advertising signs, in regard to which Mr. Gaster thought the regulations too arbitrary, seeing that there are many mildly luminous and quite inoffensive small signs which might be excluded.

[A number of photographs were thrown on the screen, principally illustrating the use of concealed gas and electric lighting in shop windows. Two of them showed the lighting of the Edgware Road show-room of the Gas Light and Coke Company; and the method by which the windows had been treated in order to comply with the requirements of the authorities. These photographs were referred to in the Chairman's (Mr. Goodenough's) observations. A letter was also exhibited from New Scotland Yard, in which the Commissioner of Police stated that the ordinary inside lighting of shops is permissible up till six p.m. at present, and that a limited number of properly shaded lights is not objected to, provided that reflection on to the pavement or roadway is prevented.]

Complying with the Regulations, without Diminishing the Effective Value of the Shop.

The Chairman remarked, regarding the letter from the Commissioner of Police, that it only said a limited amount of interior lighting could be used in shops after six o'clock; and he felt sure that a great many of the examples of interior lighting that Mr. Gaster had thrown upon the screen would not be allowed by the police under the present regulations, because it was noticed that the pavements were brilliantly illuminated by reflection from the white goods and mirrors in the windows. The trouble was to know exactly what the authorities would pass, and what they would not. It would be very much out of place to attempt any criticism as to what the Admiralty or the War Office considered should be done for protection in these critical times. All of them might have their own opinions as to the likelihood of Zeppelins coming here; they had also a pretty good idea as to what sort of reception the Zeppelins would get if they did come. If, however, the darkening of London was going, in any circumstances, to save life, those who supplied the illuminants would not be found to raise their voices against any regulation made by the authorities. But what they did want to find out was what was permissible and what was not. On these points, there was no great uniformity of instructions at the present time; and there was a variety of police practice in different parts of London. If, as the outcome of discussion, the Society could make any suggestions to the authorities which would bring about the result they aimed at, while enabling the traders of London to more effectively illuminate the interior of their shops, the discussion would not have been useless. Mr. Gaster had exhibited some photographs of one of the Gas Light and Coke Company's show-rooms, where they had been successful in meeting the requirements of the police, while at the same time not diminishing the illumination of goods inside. This was achieved by putting reflector lights quite close to the glass, high up and low down in the windows, and then covering a considerable area of the windows both above and below in front of the lights with blue paper, with the result that no direct rays of light fell upon the pavement outside the shop-windows. A very little reflected illumination only could escape, and that in a horizontal direction. The effect was rather good from the shopman's point of view, because one obtained a peep-show effect. Anyone in the street could look between the two broad bands of blue paper into the brilliantly lighted show-room; and they did look because the arrangement was an attraction. This was a suggestion that was followed out by other shop-keepers; and the police were very satisfied with the arrangement. Mr. Gaster had said that it would be useful for future reference if a careful record were kept with regard to accidents during the diminished lighting of the streets. It would, however, in order to possess value, have to differentiate between accidents occurring before and after lighting up. Statistics could be very misleading unless they gave all the factors in the situation. Undoubtedly the greater care that was being taken by drivers, and by people to be "quick" rather than "dead" [Laughter] tended to vitiate any statistical comparisons that might be made. Mr. Gaster had spoken of the glare from modern high-power street-lamps being responsible for accidents. He (Mr. Goodenough) did not altogether agree with him. Personally, he was not aware that there were any instances of street lighting in London either by gas or electricity which could be said to be dazzling either to pedestrians or to drivers of vehicles. Mr. Gaster said that presumably there was no objection to tradesmen illuminating the interior of their shops as brightly as they pleased. He (the Chairman) was afraid that this was not clear from the instructions of the police; and, judging from his Company's experience, Mr. Gaster's view did not coincide with the facts, because the police not only required the outside lamps to be extinguished, but a material reduction of the lamps inside. If the Society could make a suggestion that would allow the police to alter their instructions so that tradesmen could have full lighting of the interiors of their shops, they would substantially help the trading community and the suppliers of illuminants. Outside lamps were not merely used for lighting goods in the shop windows; they were employed very largely for the purpose of attracting the public to the road at night time. Brilliantly lighted roads of the kind were just as safe and pleasant to walk along at night time as in the day time; and he was sure the effective interior lighting of shop windows would not do away with the usefulness of outside lamps when properly arranged. Mr. Gaster suggested that, with parade lighting, the lamps should begin with low illumination and work-up to the maximum; and then work-down again. He (the Chairman) did not know what the shopkeepers would think who came first and last in the row; he thought they would be envious of the traders who had before their shops the more powerful lights. There would, he was certain, be objections to this particular theoretical suggestion.

Mr. Walsh (National Physical Laboratory) made some remarks on the subject of the diminution of the eye-dazzling effects of car head-lights.

Eccentricities of Unused Lamps.

Mr. Frank Bailey (City of London Electric Light Company) remarked that, in connection with the screening of electric arc lamps, this was not very easy to carry out at short notice; but he complimented the authorities on having left it to those responsible to find the best means of doing it. This was not an easy problem. One had to screen the lights so that they did not illuminate the sides of the buildings more than 6 feet from the ground; and this had been done by painting the tops of the lamps. He succeeded in convincing the authorities that every other lamp should be extinguished and left unobscured, so as to be ready for use when required on account of fog or any other cause. There had been some unexpected developments. These unused unobscured lamps developed some very extraordinary eccentricities. Damp got into them; and they did not keep in good condition. He had therefore to give instructions to run the lamps in daylight in order to overcome this. He thought that the gloom and depression they had to suffer now through the curtailment of the street lighting would remain in their memories for the rest of their lives.

Lighting Power in the City.—Fewer Accidents.

Mr. W. J. Liberty said it was marvellous how people generally became "acclimatized" to the absence, or smaller volume, of light. In the City a record of the accidents was being kept; and it was found that the accidents had been less—in fact, in the City there had not been one notable collision during the last three months, with lamps partially shaded and others altogether extinguished. Mr. Gaster had asked if anyone could give an approximate idea of the relation of present illumination to that previously existing. In the City of London, under the new contracts, the illumination was something like 1¼ million candle power. They had gone up from 668,000-candle power by about 100 per cent. By putting out every alternate lamp and shading the high-power ones, there was a drop of about 1 million candle power. Regarding Mr. Bailey's remarks as to the alacrity that had to be shown in dealing with this matter, a telephone message was received one morning that certain things should be done, and by lighting-up time they were done. Looking from the ball of St. Paul's Cathedral at midnight, it was found very difficult indeed to fairly locate certain objects. This gave an idea as to the effectiveness of the plans. As to fogs, the unshaded lamps which were not

[*Lumina Bureau Photo.*

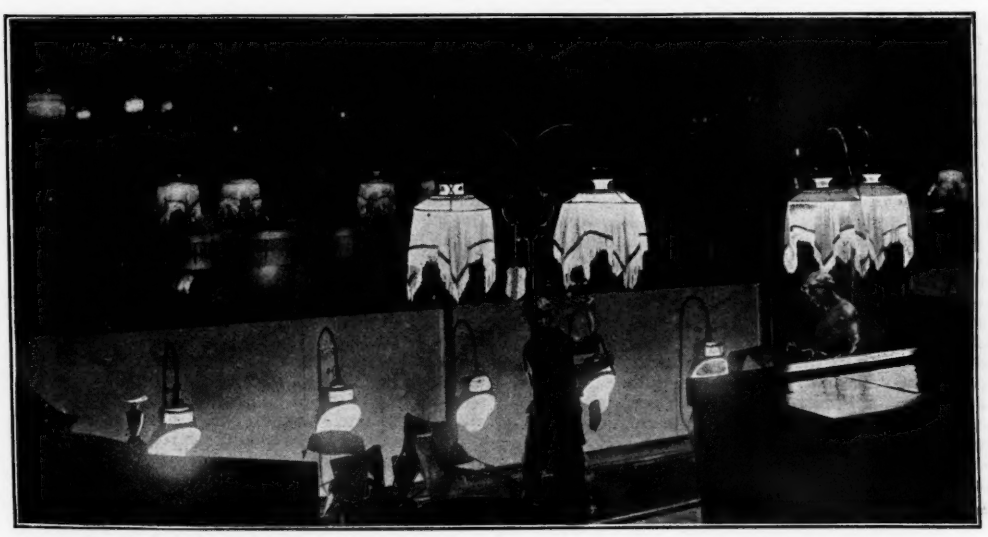
Edgware Road Show-Rooms of the Gas Light and Coke Company.

[Showing the Bottom Strip of Blue Paper on Window Concealing the Row of Burners.]

lighted in the ordinary course would permit them being promptly dealt with. In some localities, the authorities had taken away great blocks of light; in others, every other lamp had been extinguished. The result of the latter method was that, where, in certain suburbs, the lamps were staggered, the whole of the lamps on one side of a street were put out of lighting, while those on the other side were all alight. In the City, it was very easy, owing to central suspension, to adopt the system of extinguishing every other lamp. It was necessary to go back about fifty years to get anything like a comparison with the present conditions. Then flat-flame burners were used, giving about 2⅓ candles per cubic foot. Being smaller units than those now used, the lamps were placed closer together, so that there was not the spottiness that was now found. After all, so far as the suppliers of the illuminants were concerned, the public lighting was not of great importance, seeing that it represented only about 5 per cent. of the total output. It did not seem to be appreciated by shopkeepers that they could keep their interior lights going from lighting-up time to six o'clock; and only after this time they must be shaded or reduced. Christmas shopping was now coming on; and if shopkeepers could maintain their lighting up to six o'clock, it would mean a great deal in the way of spending and of trade.

The Definition of the Road Width from Above.

Mr. T. E. Ritchie remarked that the matter had so far been dealt with from the point of view of the man at ground-level; but it seemed to him the point of view of the authorities was—and very rightly—that of the man far above the ground. This applied particularly to the proposition of outlining conditions, and defining what was, and what was not, permissible. He did not think any headway would be made in this direction until such time as they had available, as he had reason to believe they would have available, the results of the very careful and very systematic work which had been undertaken by the observers who had been told off for this purpose. He thought it would be found when these facts were available that they would come to the view that it would be distinctly better to keep to a reasonable value of illumination with a reasonable degree of uniformity than to have the extraordinary spotty effect they had at the present time. As to shop lighting, in the case of one shopkeeper objection was raised to the reflection upon the footway caused by his window lighting; and it was found that the illumination was 1¼ foot-candles. Not many yards away in the centre of the roadway was a large source of light very heavily blacked around; and this gave a brightly



[*Lumina Bureau Photo.*

Edgware Road Show-Rooms of the Gas Light and Coke Company.

[Showing the Bottom Row of Concealed Burners fitted with Reflectors.]

lighted patch, the average of which was nearly 16 foot-candles. Mr. Bailey said it was permissible to illuminate the sides of the buildings by the street lamps to a height of 6 feet; but in this particular case the reason given by the authorities for objecting to the 1¼ foot-candles on the footpath was that it defined the width of the roadway. Lighting up the sides of the buildings to a height of even less than 6 feet would, it seemed to him, equally define the width of the road.

Goods Yards Treatment.

Mr. A. Cunnington (L. & S. W. R.) said it was quite obvious that a goods yard such as that at Nine Elms must have its lighting very much reduced. But the difficulties of doing this were great. Goods yards were normally sufficiently congested; and it would not do to allow them to get more so. First of all, it was thought that it would be sufficient to screen the lamps from above. But the air-ship patrols reported that this was not sufficient on account of the bright spots under the lamps. Then the light was reduced by obscuring an angle of 45° out of the ordinary arc—30° was obscured at the top and 15° below the horizontal. The most interesting lesson that could be learnt from this was that the lighting was not so much impaired as one would think that it would be. As to gloominess and depression through the present reduced street lighting, he had just recently been employing the useful "Lumeter" in the suburban place where he resided; and compared with the light obtained (say) fifteen years ago from flat-flame burners, the illumination with upright incandescent burners, came out at about six times more than it was then, and with the inverted gas-lamps at about ten times more.

Mr. F. W. Willcox thought that in the case of high-power lamps, a better job would have been made of the lighting by displacing the large lamps by small ones, and fixing a reflector over them; and as to interior shop lighting, if it had been treated like a stage in the first place, it would have been a simple matter to have reduced the illumination without coming into conflict with the regulations.

Mr. M'Intyre (Office of Works) said it would be realized that he could not take part in the discussion. But he had listened with great interest to what had been said with regard to street lighting. He had profited thereby; and he hoped that his department would also profit. Any help that could be rendered in showing how lighting could be reduced in the most advantageous manner would be welcomed.

Mr. C. Bussell also made a few remarks.

Out of Present Difficulty Good May Come.

Mr. F. C. Tilley said he thought the present conditions were going to effect a great deal of good. These conditions had caused them to turn their attention closely to the subject, and the present meeting showed the interest that had been engendered. The fact, too, that shopkeepers had had to deal with the reduction of the lighting of their premises had caused them to personally consider the matter of lighting in a way they had never done before. In some localties, tradesmen in lighting their shops had adopted the methods of their fathers; and, when once they had done this, they could dismiss the matter from any further consideration. The same with the dressing of their windows. Each tradesman had had to deal in the last two or three months with the reduction of lighting in order to comply with the regulations, and had had to dress his windows accordingly to get the best effect under the trying conditions. This had encouraged interest; and what was being learned now would have its effect when return was made to normal times. He did not know whether members of the Society had observed the marked difference that there was between the illumination obtained from obscured centrally hung lamps and obscured side lamps. If not, they should do so, because he thought that this might direct to the principles that should guide them in the lighting of the streets in future. The regulations did not offer matter upon which they could base criticism; but it would be a good thing if they could get something more definite to direct them.

Mr. Gaster [the hour being late] only touched cursorily upon two or three points. One of them was as to the effect of dazzling lights in contributing to accidents. He could quote Hanover Square. Drivers coming from there into Oxford Street complained that the high-power lights with which they were suddenly confronted dazzled their eyes so that they could not for the moment see where they were going. As to Mr. Goodenough's fear that the gradual grading of the lights in parade lighting would not meet the views of the end shopkeepers, he (Mr. Gaster) would suggest that the gradual rise in the power of the lamps could be started before the first shopkeeper was reached, and the reduction need not commence till after the last shopkeeper had been passed. Mr. Gaster added that when concealed lightning was used in the windows, and the lamps were arranged to illuminate the goods, and not to light up the pavement, the official requirements would presumably be met. With reference to Mr. Goodenough's remarks on interior lighting, he thought that quite bright illumination would be permissible inside the shop, if the actual lamps were invisible from outside, and no direct rays passed through the window on to the pavement. In many cases merely putting up an awning enabled the usual lighting to be continued. If the members of the Society could help the authorities in framing regulations in a scientific manner, or in amicably settling questions in dispute, he was sure they would only be too pleased. It was one way in which they could render assistance in these critical times.

CALORIFIC VALUE: WHAT IS IT WORTH?

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

Some apology is due for the belated date of this reply to Mr. J. H. Fairweather, and to the editorial challenge, which appear in the "Journal" dated Oct. 20 (p. 136). My excuse must be the exigencies connected with meeting a 15 per cent. increase in the demand for gas, at a time when 60 per cent. of the retort-house staff are away serving under the Colours, and, worse than that, the unlimited competition of Government contractors, who are offering panic prices for unskilled labourers. These things leave very little spare time or spare energy for other matters.

Mr. Fairweather displays considerable ingenuity in disposing of "most of my criticism," as set forth in the "Journal," Sept. 29 (p. 718), by a well-known method of argument, usually associated with the name of Mr. Wilkins Micawber. And having in this way avoided the most awkward parts of it, he devotes some space to an attempt at demolishing the remainder. There may be the magnificent flourish of the right arm, but things remain as they were; and the point is not the base of my remarks, but their correctness or otherwise, and whether they are germane to the matter under discussion. This is a matter that I am content to leave to the judgment of any reader who can record some experience with distribution with high pressure. I also submit that a large subject, such as alterations in the quality and pressure supply of combustible gas, may with advantage be discussed from all points of view, especially with regard to practical details, and not necessarily limited within the four corners of the somewhat modified conditions now presented by Mr. Fairweather. But at the present stage there is little advantage in prolonged discussion on a matter that is not greatly removed from a nonentity.

I have yet to learn that a burner complying with the conditions of complete aëration before or previous to combustion has been constructed, to say nothing about having been proved capable of general everyday use, or worthy of confident recommendation in the show-room at gas-offices. The extent of gas supply pressure required to produce such a desirable result is in an equally nebulous state. That it would have to be something far exceeding ordinary supply pressure at the present time, is shown by the fact that the best results hitherto obtained in practice do not approach within 50 per cent. of the desired end. A pressure of 10 inches at the burner has been mentioned for the purpose of argument, possibly on the assumption that if 50 per cent. of air is drawn in through the air-holes of a bunsen burner at 25-10ths pressure, 100 per cent. would be taken at four times this figure. I take it that the object of suggesting complete aëration is because such a condition is regarded as the *ne plus ultra* of combustion, as the point at which the mantle would show the highest duty. If this can be assured at 10 inches, what is the use of higher pressures? We have heard very much lately about high-pressure burners at 50 to 60 inches pressure; but what is the benefit of using such high pressures if the zenith is reached at 10 inches? In this connection it would be interesting to know the proportion of air mixed with the gas previous to combustion in a 60-inch pressure burner.

Mr. Fairweather has overlooked the fact that pressure at the burner is a very different thing to that in the mains. He is quite right as to 6 inches pressure in the mains, and might without exaggeration have claimed a much higher figure. In my own small experience 54-10ths at the outlet of the works governor has proved insufficient, and has been supplemented by a high-pressure main and booster run during maximum consumption at 90-10ths to 120-10ths. In common with the general experience, in these days of motors and bicycles, the district has been expanded by the erection of private residences just outside the limits of the borough, by which means the cheapness of country life is combined with the advantages of a town, and the high pressures named are necessary to ensure 20-10ths at the burner throughout the district. If we increase the minimum at the burner by (say) 500 per cent., how much may we expect to find necessary as the initial pressure at the works? It was this initial pressure that was in view in my previous remarks, and not the bare 10 inches at the burner. I have not questioned the possibility of high pressures in the mains. My point was in regard to meters and the inside fittings. And in connection with pressure, the absurdity of talking about a supply at 8-10ths may be pointed out. A company may do this, and also some other things, but no company works blindly according to the Act. These regulations indicate the *minimum* pressure at any part of the district, and not the average over the whole supply. The point illustrates the frequently observed fact that in practice the conditions of supply must be suited to the needs of the district, and that legislative enactments are to some extent superfluous.

Now we come to the quotations from the "Proceedings" of the Institution of Gas Engineers for 1909, which we are told have no bearing on the matter—*i.e.*, the question of hydrogen content, and the behaviour of hydrogen, either pure or in an admixture with other combustible gases, at pressures approaching the point of complete aëration. We are told that the figures quoted are based upon an unjustifiable assumption; whereas, as a matter of fact, they are plain statements of experimental results, and are not in any sense assumptions, justifiable or otherwise. When talking

about a matter involving scientific research, it is usual to look up the work of previous investigators. If the figures reported by Mr. Forshaw are to be rejected as unreliable, what is the use of research at all, and why talk about further research? The reason for quoting the figures published by American investigators was evidently to show the agreement between the results with mixed gases, as compared with those obtained with a single gas. And it is not too much to suppose that the gentleman who obtained them knew something about research work, and took some pains to ensure that the comparison should be fair and equable. According to Mr. Fairweather, the gas with the highest hydrogen content—pure coal gas—should give the highest duty. But it was found that coal gas, which would contain over 50 per cent., only gave 25½ candles per cubic foot, while carburetted water gas, which would not exceed 40 per cent., gave 33 candles. This does not go to show that hydrogen is the best friend to consumers.

Mr. Fairweather disposes of Mr. Forshaw's experiments by asserting that there is nothing about pressure in the paper, forgetting that he has not gone further than assumed conditions himself. But he overlooks the fact that (so far as I am aware) the paper is the nearest published approach to complete aëration before combustion, which is the principal plank in his platform. Mr. Forshaw appears to have been aiming at the same result, but was not able to obtain it; and it remains to be seen whether Mr. Fairweather can do better. Hydrogen and carbonic oxide happen to be alike in requiring for complete combustion one-half their volume of oxygen, or approximately 2½ volumes of air. Mr. Forshaw managed to get 80 per cent. in the case of hydrogen, and 76 per cent. in the case of carbonic oxide, mixed with the gas previous to combustion—a result that put the two gases on fairly even terms, and is a sufficient approach to complete aëration to be quoted as indirect evidence. Taken as a whole, the paper appears to me to indicate that, at ordinary pressures, carbonic oxide gives a higher duty than hydrogen, and that this advantage increases as we approach the limits of complete aëration previous to combustion. This accords with the general impression in the profession—that a mixed gas, consumed in an incandescent burner, gives a higher duty than a neat coal gas. Possibly the means by which such a near approach to complete aëration was secured were far removed from anything that is possible to the consumer. If this is so, the prospects of a reliable complete aëration burner for the consumer are not encouraging.

While the superiority of carbonic oxide over hydrogen, in the matter of illuminating duty, as evidenced by Mr. Forshaw's experiments and by the results quoted from America, can scarcely be seriously disputed, I am free to confess that the behaviour of mixed gases under combustion, as compared with that of the various constituents taken separately, is an open subject; and there is no reason why we should suppose that it is influenced by varying conditions of pressure, so long as there is a sufficient, but not excessive, air supply. Some authorities have written and spoken on the assumption that each constituent acted independently "off its own bat," or as it would do if burnt in a pure state. There is certainly a closer agreement than might be expected as a mere matter of chance between the results indicated by the calorimeter and those obtained by calculation based on the analysis. The older theories on the cause of luminosity in a flat or open flame distinctly support the view that each separate constituent acts like the individuals running in a race—putting forth its full powers without reference to its neighbours. But in present circumstances, we have to consider the effect of a large admixture with air previous to combustion, which certainly changes in a remarkable manner the character of the flame. Later experiments seem to point, in these circumstances, more in the direction of a uniform movement, like a company of soldiers marching in line at one even rate. In this instance some individuals may be stronger or quicker than others, but the fact is not evident.

THE CORROSION OF REFRACTORIES BY SALTS IN COAL.

By Alfred B. Searle, Ph.D.

During the past three years I have been devoting considerable time to the corrosion of retorts and fire-bricks by coal and coke; and the curiously contradictory results obtained with bricks and retorts manufactured of different materials and by different firms make it desirable that the matter should receive even greater attention than has already been given to it. That the subject is an extremely complex one is obvious to anyone who has studied the matter at all carefully, because the number of variable conditions is so large. Moreover, these variations are so slightly under control that it seems almost impossible at times to eliminate them or to reduce their number to within limits where they can be studied individually or in small groups.

Before proceeding to further details, let us note the chief variations which may occur:

(*a*) Temperature of the face of the retort or fire-brick in contact with the coal or coke.
(*b*) Duration of the heating in contact with the coal or coke.
(*c*) Chemical nature of the corrosive in the coal or coke.
(*d*) Chemical nature of the refractory material and the reaction between that and the salts.
(*e*) Physical nature of the refractory—particularly the closeness or openness of the texture and the size of the grains.
(*f*) Presence of adventitious materials—such as water, sulphurous acid gas, &c.—which may enter into reactions.

Taking these in turn, it is clear that the temperature and the duration of heating must be considered in making comparisons between the corrosion of two or more sets of bricks or retorts, and that unless very careful observations are made, both of the temperature and duration of the heating, variations in the amount of corrosion cannot be fully explained. It is, indeed, obvious that a corrosive salt heated for a longer period and at a higher temperature in one case than in another, will have a more violent action. It is almost impossible to determine the duration of contact between the salt and the refractory material, as there is no perfect contact between the two, but only contact at certain places. The question of chance here occurs, and prevents the drawing of entirely correct conclusions. In short, as far as temperature and duration of contact are concerned, there is not sufficient evidence in the cases of corrosion which have been examined to definitely account for the apparantly contradictory results. Even where the conditions are as uniform as can be expected under commercial conditions, the fact that the salts are distributed very irregularly through the coal is, in itself, sufficient to account for some of the vagaries of its action.

The Salts Present.

The chemical natures of the corrosive salts and the refractory material lead us much further in our consideration of the matter. In the first place, experiment shows that the salts in coal are not always of the same composition, nor are they by any means confined to what is known as "common salt." The following appear to be the chief salts present:

Sodium chloride; potassium chloride; calcium chloride; magnesium chloride; sodium sulphate; potassium sulphate; calcium sulphate; magnesium sulphate.

As the heating of the coal progresses, there is a series of reactions between the decomposing coal and the salts in it, whereby carbonates of all the metals mentioned are also formed. In addition to these salts, there is always a little iron oxide, with some carbonate of iron, and a variable amount of silicates.

All the compounds may be divided into three groups as far as their action on the retorts or fire-bricks is concerned: (*a*) Decomposable salts, (*b*) free bases, (*c*) direct-acting salts.

The decomposable salts are those which are split-up into a base and acid when heated in contact with a stronger acid; the base uniting with the stronger acid and setting the weaker acid free. Thus, calcium sulphate is decomposed into calcium oxide (lime) and sulphuric acid; common salt is decomposed into soda and hydrochloric acid. The soda and the lime combine with the fire-clay and the acids are set free and vapourize.

The free bases—oxide of iron, lime, &c.—combine directly with the fire-clay and form fusible compounds.

The direct-acting salts behave like the free bases, but are less powerful and much slower in their action, though the final product is similar to the bases. The most important of the direct-acting salts are the silicates—mica, felspar, &c.

The Chemical Actions Involved.

In order to understand the corrosive nature of these compounds, it is necessary to realize that clays and silica are both extremely powerful acids when at a sufficiently high temperature. Their acid nature is not readily recognizable when they are cold; but at a bright red heat, and at still higher temperatures, both clays and free silica behave precisely like acids of even greater power than the strongest fluid acids—such as vitriol and hydrochloric acid. Now it is a well-known characteristic of strong acids that, when in contact with salts of weaker acids under suitable conditions, the salts are decomposed by the stronger acid. This is precisely what happens when such salts are heated with clay or silica. In the case of common salt, the soda combines with the clay, forming a fusible silicate (the well-known "salt glaze"), while the hydrochloric acid is set free and escapes as a vapour. A similar reaction occurs with sulphates and carbonates. In each instance the new compound formed from the clay or silica is much more fusible than the original clay or silica; and it gradually combines with more silica or clay until the material becomes infusible under the conditions present, or else the fusible matter falls away, leaving a gap and forming flakes.

In the presence of a free base, such as lime, the clay or silica again acts as an acid, and combines with the base to form a fusible silicate, which acts like the ones just mentioned.

The direct-acting salts may be regarded as partly-formed compounds, rich in base, and consequently able to combine with more clay or silica to form compounds of a more neutral character, yet still more fusible than the original clay or silica.

It is important to note that some amount of moisture is necessary in order that the clay or silica may react with the decomposable salts; and firms who are engaged making salt-glaze ware always take care to use damp fuel (or, preferably, damp salt), in order to get a satisfactory glaze. In the same way the use of damp coal has a more corrosive action on the retorts, because the moisture present in the coal is a valuable assistant in facilitating the reaction between the clay or silica and the salts.

The speed of reaction between the salts in the coal or coke and the clay or silica of which the retorts or bricks are made, depends more on the physical state of the materials than on any difference

between the composition of a silica or a clay retort. The compounds produced with silica are more fluid and fuse more readily than those with clay; but the difference between the two is not more than is readily masked by variations in the size of the particles employed for making the retorts. With finely ground clay or silica mixed with common salt, the silica mixture melts more readily than the one containing clay; but if the clay and silica are burned before use, and then crushed so that only grains 1-25th of an inch in diameter are used, the reaction is slower, and the difference in fusibility is more marked. With a mixture of fine and coarse material, the fusibility can be so controlled that either the silica mixture or the clay mixture will melt first, according to the proportion of fine material in each. This appears to afford an explanation of some of the contradictory statements of gas engineers as regards the effect of salt on retorts made of fire-clay or silica.

Alumina Content Misleading.

It is not the proportion of alumina in the retort which is a decisive factor in the matter, but the proportion of real clay (alumino-silicic acid) present; and this is not necessarily proportionate to the alumina present, though it will be in many cases. Hence comparisons based on the high or low percentage of alumina in a retort may be very misleading.* Nor is the refractoriness of the retort material—that is, its temperature of fusion when heated alone—a reliable guide to the action of salts upon it; for the refractoriness as ordinarily defined does not take into account the presence of any reacting substance.

The only means of determining whether a retort material is likely to be more or less corroded by salts in the coal is dependent on a consideration of the amount of reacting material present in the material of the retort (as an impurity), and on the physical condition of the particles composing the retort. The smoother the surface of the retort, the less readily will it be attacked by the salts; the higher the temperature at which it has been burned previous to use, the more resistant will it be to the salts. On the other hand, a porous retort material is pre-eminently desirable for other reasons, and the open texture of such a material naturally facilitates the reaction with the salts in the coal. That the rate of reaction varies with different parts of the same retort is easily shown by a direct test, in which the same weight of salt is laid on equal-sized pieces cut from the retort and heated in a testing furnace. This is due to unavoidable differences in the texture of the material, and cannot be entirely prevented, no matter how carefully the material is mixed before the retort or brick is made. Nevertheless, it causes a great complication in comparing the effect of the salts in coal; for if different parts of one retort will show different rates of corrosion with the same amount of salt, it is easy to understand that retorts by different makers may easily show still greater variations one from another. Even when two retorts are made by the same man, some differences may be observed as regards the amount of corrosion occurring in a given time.

Effect of Water in Charge.

The presence of water in the coal or coke has a further effect than the one mentioned above, inasmuch as it also serves as a vehicle to convey the salts from the charge to the retort. In almost every case, the salts are soluble in water; and they therefore enter into solution when the charge is wet. This water is, in part, absorbed by the porous retort; and as the water evaporates it leaves the dissolved salts behind in the form of a film around the particles comprising the retort. This intimate contact places the materials in the most favourable positions for reacting; and (as may be proved by direct tests) the reaction does occur much more extensively when the salt is added in the form of a strong solution than when in the dry solid form. The presence of water in the charge thus acts in two ways: First by acting as a vehicle to secure intimate contact between the retort and the salts; and, secondly, by facilitating the decomposition of the salt by the retort material.

Summarizing, it may be concluded that the reaction between salts in coal or coke and the retort is essentially a chemical one, and that it is subject to the usual laws regulating reactions between a strong acid and a salt of a weaker acid. That is to say, with equally suitable temperature conditions, the reaction will be facilitated by water in the coal or coke, by fine particles in the retort, as well as by an open porous texture which offers greater facilities for intimate contact between the retort material and the salt. As clays are composed of much finer particles than silica, the reaction will proceed much faster with a clay retort than with one of silica; but the speed of reaction will also be affected by the fact that the compound of the salt with clay is less fluid than the similar compound with silica. The result is that a retort material containing much grog (which is coarse) may behave in a similar manner, but probably better than a silica retort; while a retort made of either silica or clay, the texture of which is not known in detail, may behave either better or worse than a retort made of the same or a different material. In these circumstances, some engineers will find that retorts high in alumina will give better results than those made of silica, while others will have precisely the opposite experience; for the clay and silica are both acids of similar power, and the size of the particles rather than their chemical nature will determine how much corrosion will occur.

Reducing Corrosion.

The corrosion will be least when the retort material is of a close surface, which is not readily penetrated by the salt solution; and in a porous material it will be least when the grains are coarse and hard-fired, as the hard-firing appears to render them less active (possibly owing to some change in their chemical composition, such as polymerization). If water can be kept out of the retort, there will be much less opportunity for the reaction to occur, as the salts cannot then penetrate the bricks so readily, nor does the reaction occur easily in the absence of moisture at the time of the decomposition of the salt. If the retorts are made of clay, a large proportion of it should have been burned and made into (coarse) grog before being mixed with the remainder of the clay, so as to keep the proportion of fine particles in the retort as low as possible. In the case of silica retorts, the smallest particles are so much coarser than the clay particles that they do not react with the same facility. By using a clay retort made with sufficient grog, and burned so as to produce a sufficiently dense surface, it is quite possible to find less corrosion than with a retort made of silica. Hence the matter of corrosion is primarily one for both the manufacturer and the engineer. The manufacturer must render all the help he can, by making the retort as resistant to corrosion as possible, in accordance with the foregoing suggestions; and the engineer must do his share, by abandoning the use of wet materials, or by recognizing that in the presence of moisture corrosion is almost bound to occur when distilling coal or coke containing an appreciable amount of soluble salts.

If entire prevention of corrosion is required—as, for instance, when it is considered impracticable to dry the coal before distillation—clay and silica retorts are unsuitable, and a basic retort material is then necessary. This cannot react with the salts, and therefore cannot be corroded by them. Of the various materials of a basic nature which are applicable, bricks made of sintered magnesite are by far the best. But, unfortunately, they are very costly; and this will in many cases prohibit their use. Moreover, they are peculiarly sensitive to sudden changes in temperature, which is a serious disadvantage in a retort material. The suggestion to line the retort with a magnesia wash is futile; for the magnesia would corrode the retort as much as the salts in the coal. The only wash available is one of chromite, or of graphite, both of which are neutral.

* This is particularly the case if bauxite (native alumina) is added to a fireclay to increase its refractoriness, as such a mixture behaves quite differently from a more aluminous fireclay with the same proportion of total alumina.

FIRE CLAY GOODS, AND THEIR USE IN GAS-WORKS.

By Thomas Holgate, F.C.S., M.Inst.C.E.

(*Continued from p.* 481.)

The subject of iron, its oxides, and the allied minerals in bricks, will now be considered. Before entering into detailed consideration of the iron present in bricks, the writer wishes to emphasize the importance of the question referred to in the recent report of the Refractory Materials Committee—viz., the desirability of keeping the ash from the fuel out of contact with the brickwork, especially of the combustion chamber. It is appropriate to do so here, because the oxides of iron are among the fluxes most generally present in ash. The coals from certain districts are especially rich in a red oxide of iron which forms a large percentage of the ash, and the ash a notable percentage of the coal. Speaking from experience gained in testing a great number of coals, and in their subsequent use on a large scale, the writer has found this ash to gain access to the brickwork both of retort-settings and of carburetted water-gas plant; and though it frequently forms a pasty mass, tending to block up both secondary air and producer gas passages, some of the ash is carried forward unfused, and collects in the flues of the recuperator.

As to what will be the exact behaviour of any such ferruginous ash will depend upon the temperatures prevailing in the retort-setting, the temperature of fusion of the ash, and the relation of the composition thereof to the components of the bricks. Professor Le Chatelier some years ago tested the melting points of the ashes of fuels; and he found that, with rare exceptions, they lie between 1100° and 1500° C. Coals even from the same pit vary greatly in regard to the fusing points of their ashes. These temperatures do not wholly represent the scope of the mischief which coal ash may do; for the contact of such a flux with the brick will appreciably lower the melting point, and may cause it to yield even to the extent of visible fusion. For example, a brick capable of withstanding 1350°C. under pressure, as per Messrs. Bleininger and Brown's standard (*ante*. p. 293), would, in contact with ash of melting point 1100°C., be very seriously affected, and in all probability would not escape deterioration, even by contact with ash of normal melting point, 1500°C.

Generally the flue dust, mainly derived from the fuel ash, when removed from the setting appears quite red, indicative of ferric oxide; at other times it is black, indicating the lower oxides of iron, Fe_3O_4 and FeO, as the result of a partial reducing atmosphere around the retorts. Whatever is the magnitude of the mischief done to the bricks by the ferric oxide, it will be greater

by the lower oxides, proceeding from two reasons. Firstly, the melting points are in the order FeO, Fe_3O_4, Fe_2O_3; secondly, the depression produced by them in a fusing mass is inversely proportional to their molecular weights, which are 71·84 for FeO, and 159·68 for Fe_2O_3, while that of Fe_3O_4 is the sum of these, and probably acts as the mean of the foregoing—viz., as FeO, Fe_2O_3. Under a low pressure—viz., 2 to 5 millimetres, as contrasted with 760 millimetres, the atmospheric pressure—O. Ruff recently found in a carbon tube heated electrically in a vacuum that ferrous oxide (FeO) melted at 1419°, ferroso-ferric oxide (Fe_3O_4) at 1538°, and ferric oxide, with decomposition, at 1548° C. To understand the relation of these to other melts at atmospheric pressure, it must be noted that alumina melted at 2020° C. under 760 mm., and at 1700° C. under 3 to 8 mm.; but the behaviour of an oxygen atmosphere may not necessarily be the same with the oxides of iron as with alumina, nor the reduction of pressure. Careful experiment by Messrs. Day and Allen showed that ferric oxide (Fe_2O_3) decomposes at atmospheric pressure into Fe_3O_4 (magnetic oxide) and oxygen at 1400° C. E. Bourry, in his book on "Ceramic Industries," 1911, says, "ferric oxide, which appears to be as infusible as alumina."

In the foregoing statements we are brought face to face with the conflicting opinions as to the fusibility of ferric oxide, which practical experience has indicated, and to which reference has already been made. Experimental data appear to lead to the conclusion that if the ferric oxide can be preserved from reduction to magnetite (Fe_3O_4) it resists heat well; but if the latter is once produced, then the further descent to ferrous oxide (the still more fusible oxide) is easily accomplished. Thus the state of the atmosphere round the iron oxide is the determining factor; for the pressure referred to above in Ruff's experiments, being of a perfectly uniform or hydrostatic character, must not be confused with the compression employed in Dr. Mellor's tests for the Committee. Besides this, if there be present with the iron oxides any soda, this ingredient will unite with the Fe_3O_4 (magnetite) at a comparatively low temperature, producing a black glaze similar to that used in pottery works. The reducing agents likely to operate in the brick-kiln or in the gas-works plant are: (*a*) Carbon, (*b*) carbon monoxide, (*c*) hydrogen. Indeed, in Nature magnetite has been found produced by the reduction of ferric oxide (Fe_2O_3) by bituminous substances associated with quartz veins. This has been confirmed by experiment, wherein yellow hæmatite was heated at 250° C. with petroleum, resulting in the production of red hæmatite containing an appreciable amount of magnetite—thus, $6Fe_2O_3 + C_2 = 4Fe_3O_4 + 2CO$.

Dr. Mellor, in his "Inorganic Analysis," refers to the production of magnetite by the burning of a filter paper on which the ferric hydroxide of a clay analysis was deposited, and also by the flame gases entering a crucible. Thus, if a brick has upon it a deposit of carbon—an occurrence in everyday practice of a water-gas plant—and this be subsequently "burnt off," the operation would almost certainly reduce to magnetite, or possibly to ferrous oxide (FeO), any ferric oxide contained near the surface. Sir William Ramsay thus describes the reducing action of gases upon the iron oxides: "FeO exists in combination with CO_2 as carbonate [see sideroplesite, *ante*], and with Fe_2O_3 in magnetite. Fe_2O_3 heated in a mixture of carbon monoxide and carbon dioxide is reduced to the monoxide. It is also produced in a crystalline form by heating iron to redness in a current of carbon dioxide, and by heating ferric oxide (Fe_2O_3) in hydrogen. Between the temperatures 330° and 440°, Fe_3O_4 is produced; but from 500° to 600° the product is FeO. At still higher temperatures, metallic iron is formed." It is to be noted here what a great reduction of temperature is experimentally found when hydrogen gas is present—viz., 330° to 440°, contrasted with 1400° found by Day and Allen when air was surrounding the Fe_2O_3, changing into Fe_3O_4. Further, the reduction to metallic iron was seen by the writer in fire-bricks taken out of water-gas plant.

Mr. S. Hilpert, since Sir W. Ramsay's writing as above, has investigated the reduction of iron oxide by hydrogen and carbon monoxide. He finds that the temperature at which the reduction of Fe_2O_3 by hydrogen begins depends on the temperature to which the oxide has been previously heated. A sudden fall in the reducibility of oxide prepared from the hydroxide occurs at 900°, at which point there are indications of a polymorphic change. Oxide prepared from the oxalate only shows this change at 1000°. In both cases the final product behaves like natural hæmatite, and is only reduced from 330° onwards. [This temperature fully agrees with that of Sir W. Ramsay given above.] It is impossible to obtain a product containing a determined quality of oxygen by these means, as the reaction takes place unequally in different parts of the mass.

Carbon monoxide is active even at 240°; but the resulting oxide is impure, containing carbon. In general, the amount of ferrous oxide (FeO) formed by heating ferric oxide in the air to 1300° did not exceed 5 per cent.; only above 1350° was there further loss of oxygen. Thus the critical temperature for ferric oxide is the same as found by Messrs. Bleininger and Brown for fire-bricks—an important coincidence. It is desirable to note the two varieties of Fe_2O_3 mentioned by Hilpert; for in 1895 Le Chatelier observed the same fact, and determined the difference in heat development when Fe_3O_4 (magnetite) was formed therefrom.

We have just been noting the ways in which the reduction of the degree of oxidation of iron may augment the fusibility of a brick; but there is a reverse phenomenon which must not be ignored. A clay may contain ferrous oxide or magnetite, and yet the brick produced therefrom may contain the iron as peroxide (Fe_2O_3), at least upon its surfaces—due to the oxidizing atmosphere in the brick kiln. For example, the siderite portion ($FeCO_3$) of the sideroplesite before mentioned may become changed in the brick-kiln to ferric oxide, as it is also known to be in Nature in the following manner:—

$$4FeCO_3 + O_2 = 2Fe_2O_3 + 4CO_2.$$

Such an improvement may, however, be wholly or partially lost in the use of the brick, if it be employed where the atmosphere is of a reducing nature.

Again, these actions of oxidation or the reverse may operate in relation to the silicates of iron found in certain clays; for, although the details are not so clearly worked out for the silicates as for the oxides, yet it is known that the persilicates are reduced to protosilicates in the presence of decomposing organic matter. As carbonaceous matter is often found in clays, and there is also contact with that of the fuel in the brick-kiln, there are present all the elements required to effect the conversion; and this may be usefully remembered when considering the researches into the fusible iron silicates in clay-wares, referred to later on. These researches all point in the same direction—viz., that as to the fluxing action of iron, the state of the atmosphere is of prime importance. We may, therefore, confidently hope that the investigations in progress at the request of the Committee will be productive of great good to gas-works practice.

(*To be continued.*)

CONSUMPTION OF GAS IN ITALY.

A RECENT issue of the "Journal für Gasbeleuchtung" quoted from an Italian paper on acetylene some figures as to the consumption of gas, electricity, petroleum, and calcium carbide in Italy for three years past. The English equivalents of the figures are as follows:—

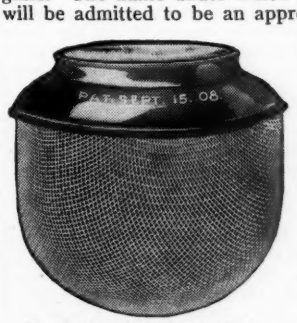
—	Coal Gas.	Electricity.	Petroleum.	Carbide.
	Cubic Feet.	Board of Trade Units.	Tons.	Tons.
1910–11 . . .	9,182,056,000	1,460,000	83,392	23,156
1911–12 . . .	9,358,634,000	1,649,000	117,337	24,913
1912–13 . . .	9,888,368,000	1,826,000	111,420	20,816

Though all four classes of illuminants exhibit an increase in the second year over the first, in the last year only coal gas and electricity continue to show an advancing consumption.

Evidently the figures given for coal gas refer only to gas used for lighting and heating; since, according to a table given in Mr. W. J. A. Butterfield's lectures on "Chemistry in Gas-Works," the total consumption of gas in Italy in 1910 was 11,985 million cubic feet. But excluding from this total the gas used for industrial purposes, that used for lighting and heating only was, in 1910, 9024 million cubic feet.

A SUBSTITUTE FOR GERMAN GLASS.

ATTENTION is drawn by the Provincial Incandescent Fittings Company, Limited, of Manchester, to a timely introduction of theirs into England, in the form of a globe to replace German glass. The name under which it will be known—"Nobrak"—will be admitted to be an appropriate description, inasmuch as the globe, which is brass mounted for fitting purposes, consists of a very fine wire-mesh coated with white enamel. The inside of the brass mounting also is white enamelled, so acting as a reflector. These patent safety wire globes will shortly be on the market in various patterns, for both upright and inverted burners. By this means, the necessity for replacing at more or less frequent intervals broken glassware will be obviated.



Enamelled Wire-Mesh Globe.

A point made is that the globes (which at a distance have much the appearance of glass) may be easily washed and cleaned with warm water and soap. The inventor further claims them to be rust-proof, and of a greater transparency than white glass shades. For an article of a character which will do away with glass maintenance charges, there should certainly be a good field in connection with the lighting by incandescent gas of factories, warehouses, and shops.

An installation of the "Notanos" plant for washing pan ash which Messrs. Head, Wrightson, and Co., Limited, have erected at the works of the Wandsworth, Wimbledon, and Epsom District Gas Company, was described and illustrated in a recent issue of the "Iron and Coal Trades Review."

ILLUMINATION AND THE ILLUMINATING ENGINEERING MOVEMENT.

By Leon Gaster.

[A University Lecture to the Manchester and District Junior Gas Association, Dec. 5.]

In the opening paragraphs of his lecture, Mr. Gaster pointed out that, though he intended to deal mainly with illumination, and the application of light, rather than with illuminants, it might be of interest to make a brief survey of the progress of the efficiency of gas lighting since its introduction. In doing this, he remarked that there is still great scope for progress. Even most efficient lamps are still very far from perfection. Many authorities have attempted to estimate the percentage of the total energy given by a lamp appearing in the form of light. Their estimates differ, but all agree that the actual percentage is very small. According to Lux, an ordinary inverted gas-mantle gives less than 1 per cent. of its total energy in a luminous form; and on this basis even the best high-pressure lamp would only have an efficiency of a few per cent. There are still obvious opportunities for greater perfection, in the design both of the burner and the mantle. It is likely that we have by no means come to the end of possible improvements in the form of more intimate mixture of gas and air and more perfect combustion; and perhaps some discovery in the field of rare earths might give us a more efficient form of mantle.

Applications of Light—Illuminating Engineering.

Proceeding, the author said that the last ten years have seen a great advance in the facility for producing light. They have also seen a great development of interest in methods of using light to the best advantage. The formation of the Illuminating Engineering Society in 1909 has done much to stimulate public interest in the question; and it has also had the effect of providing a common platform where gas and electricity can work together on points of common interest. I feel sure the recognition is gaining ground—more especially in cities where both the gas and electrical supplies are municipally owned—that it profits little for the representatives of the two illuminants to attack each other. It would be far better for both to concentrate their attention on the education of the public, who do not yet appreciate the benefit of good lighting at its proper value. While there remain in this country underlighted or badly-lighted schools, streets, or public buildings which are illuminated in a manner quite out of keeping with their importance and architectural distinction, there is ample scope for the energies of representatives of both systems of lighting.

In the Illuminating Engineering Society, our policy has been to interest various public bodies and authorities in the subject, knowing that once their goodwill has been gained their influence will gradually make itself felt among the general public. For example, our reports on school lighting have been brought to the notice, and have been favourably received by, the leading educational authorities. In dealing with library lighting, we sought the co-operation of the Library Association. We were largely instrumental in bring about the Joint Committee on which members of the Institutions of Gas and Electrical Engineers, the Institute of Municipal and County Engineers, and our own Society worked together on the very difficult and complicated task of preparing a Draft Specification on Street Lighting. Lastly, during the past year we have seen the formation of an International Commission on Illumination—a body created by the enlargement and modification of the old Photometric Commission, so as to be truly representative of the various nationalities interested and the chief systems of lighting. It would be great cause for regret if the work of this Commission should have to be temporarily suspended by the separation of countries caused by the present war.

These movements show that illumination is making its way into the minds of people all over the world, and illustrate the manner in which gas and electrical engineers are now working together for the mutual benefit of the two systems of lighting.

The Secret of Good Lighting.

Discussing next a few of the obvious characteristics of good lighting, Mr. Gaster dealt with the human eye, and showed how vitally important is the part played by the eye in lighting problems. If, he said, we expect the eye to accommodate itself to violent and sudden changes, it is bound to suffer; and the avoidance of these abrupt transitions from great brightness to comparative darkness is one of the most important points in distinguishing good lighting from bad. There are two ways in which these violent contrasts may be produced: (*a*) The eye may be exposed to great brightness immediately after dense darkness, and before it has time to adjust itself to the new conditions. This is what occurs when one tries to work by a flickering light. It is the effort to accommodate to the rapidly changing illumination that makes these conditions so troublesome to the eyes. (*b*) The eyes may be exposed to a very bright object and to a comparatively moderately illuminated object simultaneously. In this case, the pupil aperture and the retina adapt themselves to the brightest thing in the field of view; and the eyes cannot distinguish the moderately illuminated things with any ease. In full daylight we are able to bear a very strong illumination without harm, because it is universal. Everything is keyed-up to the same pitch of brightness. On the other hand, a high-pressure incandescent gas-mantle seen against a dark background is very trying to the eyes. Most probably it is rendered less troublesome when the background is white, so that the contrast is less severe. This is one point in favour of the so-called semi-indirect systems of lighting.

Avoidance of Glare.

It is, of course, difficult to give precise rules applicable to all interiors. In considering what is likely to cause the eyes discomfort, much depends on the nature of the work to be done. The following statement by Professor Weber covers the ground fairly completely. Glare will occur: (*a*) If the ratio of the intrinsic brilliancy of the source of light to that of the illuminated surroundings exceeds a certain limit. This ratio should not exceed a value of about 100. (*b*) If the absolute intrinsic brilliancy of the source exceeds a certain value. The brilliancy of the open candle flame (about 2½-candle power per square inch) might be taken as the safe limit. (*c*) If the angle between the direction of vision of the eye when applied to the work it is called upon to do—*e.g.*, when gazing at a desk, blackboard, or diagram on the wall, &c.—and the line from the eye to the source of light is too small. This minimum angle might be provisionally assumed to be 30°. (*d*) When the extent (apparent area) of the illuminating body is too large. The source should not subtend an angle of less than 5° at the eye. The chief points on which emphasis should be placed are that wherever possible the lights should be put high up out of the field of view, and that effective methods of shading should be employed.

Amount of Light Required for Various Operations.

Referring to this subject, the lecturer said that the question of the proper shading of lights really goes to the root of successful illuminating engineering. Another fundamental point in illumination is the amount of light required for different purposes. A number of tables have been prepared by several firms giving the approximate foot-candles for various kinds of work; but it is admitted that the standard varies in practice very widely, and that in many cases more exhaustive experiments will be needed in order to ascertain the actual amount of illumination required in certain trades. As an illustration, I may mention the variations in illumination referred to by Mr. Goodenough in his paper on this subject before the Illuminating Engineering Society in 1912.* It is quite obvious that if one finds the same identical processes being carried out by widely different amounts of light, the illumination in some cases must be insufficient and in others probably excessive.

Globes, Shades, and Reflectors.

The design of globes, shades, and reflectors was discussed somewhat fully in a recent paper before the Illuminating Engineering Society by Mr. J. G. Clark and Mr. V. H. Mackinney.† Speaking generally, their chief functions may be said to be: (*a*) To tone-down the excessive brilliancy of an illuminant. (*b*) To direct the light where it is chiefly needed. (*c*) To soften the shadows. (*d*) To serve as a decorative object.

Naturally, these four functions are not always equally important. Sometimes the direction of the light is the most vital matter. There are other branches where artistic considerations are of paramount importance. The question of shadows comes into calculation in most cases where artistic considerations apply. An unscreened source of great brilliancy, besides giving an impression of glare, will tend to produce undesirable dense hard shadows, which are usually objectionable from an architectural standpoint. Shadows, it is true, are necessary to show-up pillars, alcoves, mouldings, &c.; but hard edges are not desired.

There are still a great many shades in this country which fulfil none of these requirements. For example, shallow forms of opal and enamelled iron shades which scarcely cover the mantle at all, and have really little influence on the distribution of light therefrom. Some of these shades were formerly imported in large quantities, and are now no longer available. Let us hope that this check may result in a more scientific, even if slightly more expensive, variety coming into use.

Globes at the present time are: (1) Clear glass, (2) etched or sandblasted glass, (3) opal or some similar variety of white glass, or (4) prismatic glass. It is difficult to state the absorption of light with any precision without showing a specimen of the exact material at the same time. The figures of various qualities of glass vary from 5 to 10 per cent. for clear glass to as much as 40 to 50 per cent. for very heavily obscured material.

For shades and reflectors the range of material is considerably greater. Besides the above-mentioned sorts of shades, paper, silk, metal, and cardboard are used; and Dr. Voege has recently recommended the use of marble. Estimates of the amount of light vary very greatly. It may be pointed out that a reflector may absorb very little light indeed, and yet may be a very bad reflector. Obviously a very shallow form, at a considerable distance above the mantle, will absorb very little light, but merely because only a small portion of the light reaches it. It is therefore important, when noting the amount of light reflected, to also state how far the reflector has satisfied the conditions referred to above.

Illuminating Engineering Calculations.

Until quite recently, it was not very generally appreciated how

* See "Journal," Vol. CXVII., p. 872. † *Ibid.*, Vol. CXXI., p. 545.

greatly the distribution of light from standard types of lamps varies. I have in mind two forms of high candle-power low-pressure lamps, both stated to give the same candle power and approximately the same gas consumption. But the polar curve of light distribution differs widely. In one case, the maximum candle power occurs at an angle of 10° below the horizontal; in the other a great majority of the light is concentrated vertically downwards. A change like this can be readily produced by a slight alteration in the shapes of the reflectors. Its importance is realized by the expert; but the man in the street might conceivably buy either one without realizing that the circumstances in which they could best be used are radically different.

The advantage of giving the polar curve of illuminants is that an illuminating engineer can readily calculate therefrom the illumination produced at any given distance from the lamps; and with a little care he can also ascertain the best distance apart in order to produce approximately uniform illumination. At the recent Optical Convention, it was striking to observe how many manufacturers are now publishing polar curves of their lamps. I believe that in the future the value of such data will be even more generally appreciated. With their aid an engineer will be able to predetermine the illumination of any given installation, and afterwards check the results with an illumination photometer. This was done in the case of a number of installations (both gas and electric light) by Professor W. C. Clinton this year; and the actual results in most cases came surprisingly close to the calculated values. The only real element of uncertainty is the amount of light reflected from the surroundings. This makes it more difficult to predetermine installations using indirect and semi-indirect lighting; but even in this case it is possible to work out a result when sufficient care is taken. I would like to refer those interested to Professor Clinton's paper before the Illuminating Engineering Society.*

Naturally, in such calculations a reasonable latitude must be allowed, according to the local circumstances. One could not, for example, expect that a gas-lamp would give quite the same results, in whatever district it was used. The quality of gas supplied would have some effect. One must also be prepared for a certain deterioration in light some time after the erection of a brand new installation. The mantles will probably not be giving their original candle power when renewed; and, as Mr. Clewell has shown, unless considerable care is expended on keeping the globes, &c., clean, some loss of light due to deterioration and to deposits of dust may be expected.

Indirect and Semi-Indirect Lighting.

Indirect and semi-indirect lighting form a special variety of shading. Hitherto it has been mainly used with the electric light; but there is no reason at all why it should not be applied to gas lighting as well. The earliest forms of indirect lighting took the form of lamps concealed in the cornices of a room. This is not often used now; and it is more usual to suspend the lights in bowls from the ceilings. If the bowls are opaque, it is called indirect lighting; if they are translucent (white glass, prismatic glass, &c.), semi-indirect lighting. Semi-indirect lighting is now being applied to gas lighting with considerable success; and it is probable that this system will be found preferable to indirect lighting pure and simple.

Estimates of the relative efficiency of the direct and indirect lighting differ; but we shall probably not be far wrong in saying that twice the gas consumption will be required with indirect lighting to produce a certain illumination over the direct system. One of the chief advantages of indirect lighting is the fact that the light is distributed from such a wide area that there is less danger of inconvenient reflections from glazed paper and polished surfaces, &c. On the other hand, some people complain that it has a depressing effect, and that there is a sense of "something wanting." The opinion seems to be gaining ground that semi indirect lighting, which combines the advantages of the direct and the indirect methods, is the better of the two.

There is one other form of indirect lighting that deserves mention—*e.g.*, the "pedestal" system, where lights are concealed in reflectors mounted on pedestals so as to be completely concealed from view, and to direct the light upwards on the ceiling. This method was recently used in conjunction with upright burners for lighting a lecture hall in the United States.

It may perhaps be of interest to summarize briefly the conditions required in a few typical classes of installations.

Domestic Lighting.

For the lighting of the home, each room presents a different problem. In the space available it is impossible to discuss each of these in detail; but I may refer to the article on this subject published in the "Illuminating Engineer" for October last. I would like to lay stress on the importance of better lighting in the kitchen, scullery, bed-room, and children's reading-room, which in the past have not received the attention desired.

One can hardly expect things prepared in the kitchen to look well if the preparation is carried out by insufficient or badly arranged illumination. For example, silver may not be cleaned properly. When it is arranged in the strong light on the dining-room table, defects that were probably not detected in the poor light in the kitchen may reveal themselves. In general, it might be laid down as a principle, in the kitchen as in the factory, that things should be prepared by an illumination at least as strong as that by which they will subsequently be inspected.

A special claim for good lighting in the home may be made on behalf of the children. It was pointed out by the writer in a paper before the National Gas Congress last year that good illumination in the home and the school is necessary as an example. Otherwise the children get accustomed to unsatisfactory lighting conditions, and, when they grow up, reproduce the defects in their own homes.

School Lighting.

The lighting of schools has been the subject of two reports by Joint Committees formed by the Illuminating Engineering Society—one dealing with artificial lighting and the other with daylight.* As regards artificial lighting, the chief requirements are that a minimum illumination for reading of 2-foot candles should be provided, and for special work [art classes, drawing offices, workshops, and stitching with dark materials, &c.] a minimum of 4-foot candles. On blackboards an illumination 60 per cent. in excess of that in the rest of the room is desirable. Other important points are that no lamps should come within the solid angle subtended at the eye by the blackboard and the space 2 feet above it. In general, no incandescent surface should be visible to the eyes of students or teacher while carrying on their usual work.

The lights and surroundings should be so arranged as to avoid inconvenient reflections of polished objects or undesirable shadows. I may mention that two school-rooms lighted by direct and semi-indirect lighting means were fitted up by the Gas Light and Coke Company for the benefit of the Committee engaged in this work. A model school-room on similar lines was afterwards shown at the National Gas Exhibition.

As mentioned previously, a Committee of the Society have already dealt with library lighting; and recommendations generally similar to those presented for schools have been made. A distinction has, however, to be drawn between the requirements of a reading room, a reference library, a lending library, &c.

Industrial Lighting.

Industrial lighting is such a huge problem that I can only touch the fringe of the subject it presents. Briefly, we may say that recent researches have shown that there is a connection to be traced between bad illumination and certain classes of accidents. An instance of mishaps caused through men stumbling about in semi-darkness has been mentioned in the recent official reports of H.M. Inspector of Factories. In a paper before the Royal Society of Arts in 1913, the author gave some information on the matter and pointed out the claims of good lighting. (*a*) As a hygienic necessity, (*b*) as a means of preventing accidents, (*c*) as desirable on purely economic grounds.

In the case of detailed work in a factory, the proper screening of the lights is the most important matter. They should be arranged so as to illuminate the tool, without throwing any rays into the eyes of the worker, and with a view to reducing to a minimum inconvenient reflection from polished materials. During my visits to factories I have found that two extremes in lighting are apt to occur. Either they rely on general illumination alone, or else they use exclusively local lighting from lamps with opaque shades which illuminate the work strongly but leave the surroundings too dark. Personally, I am disposed to prefer well-shaded local lights for all detail work, but also a mild general illumination in the rest of the room; so that the extreme contrast which is apt to be a feature of local lighting alone is avoided.

The cleaning of lighting units must not be neglected. Mr. Clewell ["Factory Lighting," 1914] has found that in the average factory a diminution in light of 4 L—50 per cent.—may occur as a result of three weeks' neglect. Another important point is the diffusion of the light by white surroundings, so that it gets into the corners of the machinery and thus inconvenient shadows are diminished.

The case for good lighting from an economic standpoint is very strong, and was well put by Mr. Franklin Thorp in his paper before the National Gas Congress last year. For example, he pointed out the vital effect of illumination on the ease with which supervision is carried out of complicated looms through which as many as 2500 threads may pass per minute. If one of these threads breaks for any length of time, general spoilage and stoppage would result; and a defect of this kind is very apt to go unrecognized if the operations are carried on by insufficient light. In a great industrial district like Manchester, the importance of these points should be thoroughly recognized. The lighting of large engineering shops and mills may form a very suitable subject for an evening's discussion on a future occasion when the Illuminating Engineering Society meets in Manchester, which we hope to do some day shortly.

Shop Lighting.

The subject of shop lighting has been brought prominently to our minds by the official regulations in London with a view to diminishing the danger of possible raids from hostile aircraft. The chief point aimed at by these regulations appears to be the screening of brilliant lights in the windows, and the avoidance of illumination on the pavement. It is interesting to notice that these regulations are in the same direction as the recommendations made by me some years ago, and severely criticized

* See "Journal," Vol. CXXV., p. 898.

* See "Journal," Vol. CXXIII., p. 173.

in some quarters at the time. In the Illuminating Engineering Society the view has been consistently expressed that the proper method of lighting shop windows is to conceal the lights from view, on the same principle as stage foot-lights. The important thing is to show the illuminated goods and not the lights themselves. Now most of the leading stores in London have adopted this method. As an example of the system which is designed to comply with the official regulations, I may mention the showrooms of the Gas Light and Coke Company in Edgware Road, of which I am showing an illustration [see p. 533].

In London for the time being the system of parade lighting has practically ceased. High-pressure gas lighting on this principle has been developed in a very enterprising manner during the last few years. Personally, I have always felt that the sudden changes in brightness when one comes into a section lighted in this way is very trying, and that more artistic results might be secured by screening the lights with decorative lanterns made of white glass or some other diffusing material.

I will not stop to discuss the lighting of clubs, restaurants, music halls, &c., all of which offer their respective problems. But I should like to point out that there are some varieties of installations for which gas is not used to any great extent at the present time, and for which the opportunity would be greater if more artistic fittings were designed. In the United States there has recently been considerable progress made in this direction, and I am glad to see in this country, too, there are now many more handsome fittings on the market.

For the lighting of very large halls, gymnasiums, swimming baths, &c., high-pressure gas lighting is favourably placed if properly applied. As an illustration of special design, I would like to refer to the lawn tennis courts in the South Metropolitan Gas Company's district at Dulwich, where the arrangements of the lights to give the best conditions for playing have been carefully worked out. Very similar systems have been used with electric light in some courts at Liverpool. Here we see an example of the many problems which are of equal interest to representatives of gas and electricity. Other examples of special design are provided by the arrangements made by the Gas Light and Coke Company for lighting rifle ranges, swimming baths, &c.

Street Lighting.

Street lighting, again, is much affected in London at the present time by the official regulations for the diminution of lighting. The situation is interesting, because we are now seeing conditions that probably have not occurred during the last fifty years; and experiments are being tried that could never be attempted in normal times. It is quite conceivable that our theories as to what constitutes good street lighting will be considerably modified by the present experience.

The problems of street lighting were somewhat fully discussed in the paper by Mr. A. P. Trotter read before the Illuminating Engineering Society last year. As the problems are necessarily considered in connection with the measurement of illumination in the streets, it may be of interest to summarize some of the chief views as the constitution of a specification on street lighting.

In the report * prepared by the Joint Committee, of which Mr. Trotter was a member, it was proposed that streets should be classified, in terms of minimum horizontal illumination, as follows:

Class A	. . . . .	0·01 foot-candle
,, B	. . . . .	0·025 ,, ,,
,, C	. . . . .	0·04 ,, ,,
,, D	. . . . .	0·06 ,, ,,
,, E	. . . . .	0·10 ,, ,,

the measurement being always made in a horizontal plane approximately one metre from the pavement. Streets having a minimum illumination below 0·01 foot-candle are preferably regarded as "beacon-lighting." There will also be many streets—I believe there are some in Manchester—with a minimum illumination well above 0·1 foot-candle. But these are exceptional, and for the moment might be considered as being more strongly lighted than urgent necessities demand.

From a scientific standpoint, there is much to be said for this system of specifying street lighting. On the other hand, there are those (mainly Continental authorities) who consider that the mean horizontal illumination in the streets ought, strictly speaking, to be determined, as this would give a measure of the total amount of light allotted to the pavement and roadway. In practice, however, it would be a tedious operation to carry out.

Again, there are some who contend that at present measurements of illumination cannot be arrived at with sufficient exactitude, that the results are disturbed through reflection from neighbouring buildings, &c., and that the best plan is to measure the candle power of the lamps at certain specified angles. In Westminster, for example, the candle power is measured at angles of 20° and 50° below the horizontal; and this is regarded as roughly equivalent to the mean hemispherical candle power.

Another view, taken by Dr. Louis Bell and others, is that no measurements in the streets, however valuable they may be for experimental purposes, are sufficiently accurate for a specification, if a penalty is to be imposed for non-fulfilment of contract. Dr. Bell considers that the conditions should be judged by very careful tests of lamps in the laboratory, where all the refinements of measurement are available.

All these systems are being exhaustively studied by an expert Committee appointed by the National Electric Light Association (U.S.A.), which has already issued a preliminary report.* It is interesting to observe that all the authorities now recognize the desirability of some clause relating to the illumination provided. Clearly it is this illumination the consumer pays for, and in which he is mainly interested. The matter is one that should appeal to both gas and electrical engineers; and it is a significant sign that in Manchester a Joint Committee composed of three sections—the gas and electrical representatives and some neutral advisers—was recently formed to consider the lighting of the city.

Another enterprising step was the appointment of two independent experts to advise on these matters. I have always advocated that street lighting should be treated in a strictly impartial manner; all methods of lighting being given their fair chance. The experiments on street lighting that have recently been carried out in Manchester have been watched with great interest in other parts of the country. The plan recently adopted, of allowing miles of streets to each illuminant, where experiments on all the latest improvements can be tried, seems a very good one, that might with advantage be followed in other cities. I understand that the experiments are to be continued for another eighteen months before any decision is taken. The data collected during this period should prove most useful for future reference.

On the whole it would appear—as has been very well said by the Committee of the National Electric Light Association—that, before a specification can be satisfactorily agreed upon, we want to have a clearer conception as to what exactly good street lighting consists of?

I do not think there is complete agreement on this point, though there are certain general recommendations that could be made. I think that most people who have carefully considered the matter would agree with the following suggestions:

1.—The illumination on the roadway and pavement should be, within reasonable limits, as uniform as possible. At points of special importance, busy crossings, &c., the illumination might sometimes be increased with advantage.

2.—It is desirable to avoid as far as possible abrupt transitions in brightness when passing from side streets to main streets. Sudden changes are apt to dazzle the eyes of drivers, and accidents have sometimes been ascribed to this cause.

3.—Some method of diminishing the intrinsic brilliancy of modern street-lamps, and at the same time distributing the illumination more evenly, is desirable.

4.—Most of the light should be directed downwards on the pavement and roadway, but not all—a certain percentage is needed to show off the buildings lining a street.

Our present experiences in London seem to confirm these views. At present, the number of lights is diminished, and those that remain have been provided with obscuring bands which leave the buildings lining the street in semi-darkness, and give a very spotty illumination on the roadway. Anyone driving must agree that the sudden transition from a bright patch to a dark one is trying. We have here an example of the extreme in want of uniformity. On the other hand, the fact of the bright mantles and arcs being kept completely out of sight seems to me an undeniable improvement. The effect is depressing, however. Ultimately some intermediate condition of things, possibly involving the screening of the source with translucent diffusing glass, may become popular.

There are great opportunities also for improving the lighting of large cities from the artistic standpoint. In a paper before the London Society this year, I pointed out the scope for ingenuity in the design of lamp posts and lanterns, lamps outside public buildings, and the lighting of parks by night. When the war is over, I hope that a movement will be started in this direction. The appearance of a city by night is remembered by many people long after they have forgotten its main streets and buildings, and there are endless possibilities in the use of light for decorative effect. Complaints have been made regarding the giant illuminated signs on the Embankment in London; and I agree that many of these signs are a great disfigurement. But it is still open to our leading architects to take more interest in the use of light from an artistic standpoint, and to make the lighting of our cities an integral part of their structural design.

Finally, I am glad to have this opportunity of bringing before you the aims of the Illuminating Engineering Society. We may justifiably feel that we have accomplished a good deal during our short term of existence; but we could do a great deal more provided we get the necessary support. From the start the Society has been organized with an international connection; but 70 per cent. of the members reside in this country. London has been the centre; but we are now anxious to adopt the suggestion made by Mr. Shadbolt at the National Gas Congress last year, and extend our activities to other parts of England. Manchester, being a city in which both illuminants are owned by the Municipality, is in a very favourable position to take up the movement, and its great industrial activities make illuminating engineering a subject of vital interest. Our first aim is to increase our membership in this neighbourhood, with a view to eventually holding special meetings; and I hope that many of those interested in lighting matters will give their support to the movement.

* See "Journal," Vol. CXXII., pp. 250, 397.

* See "Illuminating Engineering," Vol. VI., p. 463.

INTERNAL-COMBUSTION ENGINES FROM A COMMERCIAL STANDPOINT.

THIS was the subject of a paper recently read by Mr. JAMES G. WALTHEN, who is connected with the British Westinghouse Electric and Manufacturing Company, Limited, before the Manchester Association of Engineers. The author said he proposed, first, to take a commercial outlook upon some of the many improvements and developments which have been effected in internal-combustion engines; and, secondly, to consider the present-day position of these engines from a commercial standpoint. He claimed that commercial influence has often proved to be a beneficial factor in the development of design; the result being a high standard for a British-made engine in the markets of the world. The following are some extracts from the paper.

IMPROVEMENTS IN HORIZONTAL ENGINES.

In considering some of the mechanical improvements adopted upon horizontal gas and oil engines during the past ten years, it will be observed that the modern gas-engine is free from many faults which gave rise to adverse criticism upon the early types. Among these might be mentioned the unsupported cylinder, weak crank-shafts and connecting-rod bolts, the unbalanced crank, and faulty lubrication and ignition. All are more or less familiar with the old-style overhanging cylinder bolted up to the engine-frame. The modern engine has its frame extending well back, forming part of the water-jacket; thus supporting the cylinder throughout its length—only the breech end containing the valves being overhung. The connecting-rod bolts and crank-shafts have been strengthened. Lubrication is automatic—the main bearings by means of ring lubrication; the piston and cylinder, by pump lubrication. The application of pump lubrication to the cylinder and piston is very beneficial, as it ensures the lubricant finding its way to the back end of the cylinder. Had this systen been applied earlier, there would have been fewer complaints of worn-out liners after only a few years' service. Ignition arrangements are greatly improved, magneto ignition having entirely superseded tube ignition, except upon very small town-gas engines.

Without attempting to enumerate all the improvements made upon the modern type of engine, the following will appeal to a user: Steadier working, reduced wear and tear, greater reliability, decreased attendance, and reduced fuel consumption. It is now the general practice among first-class engine builders to fit balance-weights to the crank upon all horizontal engines. The former practice was to fit them only upon the "electric lighting" type, and to effect a partial balance upon the industrial or the "ordinary" type engine by making allowance in weight at the fly-wheels. Such engines caused complaints and vibration troubles. Balance-weights fitted to the crank ensure more perfect balancing of the moving parts, and permit of a higher revolving speed with an increased output for the engine. It pays, therefore, to adopt balance-weights for all engines.

The following table gives a few examples of town-gas engines taken from the catalogues of well-known makers. It shows the revolutions and brake-horse-power for each engine without its balanced crank (A and B) and with its balanced crank (C and D); the speed and power increases being stated in each case. It does not follow that the gain in engine power is in direct ratio to the speed increase, as the power is controlled also by the valve areas and piston speed; but it will be observed that the power increases are considerable:—

Size of Engine Bore and Stroke.	Without Balanced Crank.		With Balanced Crank.		Speed Increase.	Power Increase.
	R.P.M.	B.H.P.	R.P.M.	B.H.P.		
	A.	B.	C.	D.	Per Cent.	Per Cent.
6½ × 12	230	7·75	280	8·75	21·7	13·0
8 × 16	210	16·75	250	18·50	19·0	10·4
8½ × 20	200	23	250	28·00	25·0	21·6
11 × 19	190	34	230	40·50	21·0	19·2
11½ × 21	190	43	230	50·00	21·0	16·3
17 × 24	170	94	200	108·00	17·6	14·9

In addition to the improvements made in mechanical construction, the horizontal gas-engine has been improved in economy and brake-horse-power capacity. This especially refers to the town-gas engine, and is mainly due to increasing the compression

TABLE A.

Max. B.H.P. of Engine.	British Thermal Units per B.H.P.		Cubic Feet of Gas per B.H.P.-Hour (Gas of 560 B.Th.U. Net Value).	Cost (in Pence) of Gas per B.H.P.-Hour (Engine Working on a Three-Quarter Load), with Gas Varying from 10d. to 4s. per 1000 Cubic Feet.														
	Load.	B.Th.U.		10d.	1/-	1/2	1/4	1/6	1/8	1/10	2/-	2/3	2/6	2/9	3/-	3/3	3/6	3/9	4/-
2·75	Full	15,700	28																
	¾	16,800	30	·300	·360	·420	·480	·540	·600	·660	·720	·810	·900	·990	1·080	1·170	1·260	1·350	1·440
	½	17,900	32																
6	Full	14,000	25																
	¾	15,100	27	·270	·324	·378	·432	·486	·540	·594	·648	·729	·810	·891	·972	1·053	1·134	1·215	1·296
	½	16,800	30																
8	Full	12,880	23																
	¾	13,720	24·5	·245	·294	·343	·392	441	·490	·539	·588	·661	·735	·808	·882	·955	1·029	1·102	1·176
	½	15,120	27																
11	Full	11,760	21																
	¾	12,880	23	·230	·276	·322	·368	·414	·460	·506	·552	·621	·690	·759	·828	·897	·966	1·035	1·104
	½	14,840	26·5																
14·5	Full	11,500	20·5																
	¾	12,320	22	·220	·264	·308	·352	·396	·440	·484	·528	·594	660	·726	·792	·858	·924	·990	1·056
	½	13,160	23·5																
19	Full	10,640	19																
	¾	11,760	21	·210	·252	·294	·336	·378	·420	·462	·504	·567	·630	·693	·756	·819	·882	·945	1·008
	½	12,600	22·5																
27	Full	10,410	18·5																
	¾	11,480	20·5	·205	·246	·287	·328	·369	·410	·451	·492	·553	·615	·676	·738	·800	·861	·922	·984
	½	12,320	22																
34	Full	10,080	18																
	¾	11,200	20	·200	·240	·280	·320	·360	·400	·440	·480	·540	·600	·660	·720	·780	·840	·900	·960
	½	12,040	21·5																
44	Full	9,800	17·5																
	¾	10,640	19	·190	·228	·266	·304	·342	·380	·418	·456	·513	·570	·627	·684	·741	·798	·855	·912
	½	11,760	21																
52	Full	9,800	17·5																
	¾	10,640	19	·190	·228	·266	·304	·342	·380	·418	·456	·513	·570	·627	·684	·741	·798	·855	·912
	½	11,760	21																
61	Full	9,520	17																
	¾	10,360	18·5	·185	·222	·259	·296	·333	·370	·407	·444	·500	·555	·610	·666	·722	·777	·833	·888
	½	11,200	20																
75	Full	9,520	17																
	¾	10,360	18·5	·185	·222	·259	·296	·333	·370	·407	·444	·500	·555	·610	·666	·722	·777	·833	·888
	½	11,200	20																
95	Full	9,520	17																
	¾	10,360	18·5	·185	·222	·259	·296	·333	·370	·407	444	·500	·555	·610	·666	·722	·777	·833	·888
	½	11,200	20																
105	Full	9,520	17																
	¾	10,360	18·5	·185	·222	·259	·296	·333	·370	·407	·444	·500	·555	·610	·666	·722	·777	·833	·888
	½	11,200	20																

pressures; the additional output being obtained notwithstanding a considerable reduction in the heat value of town gas.

In the early days, manufacturers listed their engines stating the rated power with town gas of 700 B.Th.U. per cubic foot; the compression pressure then being in the region of 60 lbs. per square inch. Within recent years town gas of approximately 560 B.Th.U. net value has been assumed when stating the brake-horse-power. The present trend of affairs in the gas world is in the direction of further reducing the heat value of town gas; and the old standard measurement by candle power is being discarded in favour of the more satisfactory calorific standard. Parliament has already approved in many cases of gas being supplied at a net heat value of 480 to 500 B.Th.U.; and it is quite probable that within the next few years this standard will be universally adopted. When certain gas undertakings reduced the quality of town gas too suddenly, users of old gas-engines experienced a falling-off in power, and many complaints were received. Though this would appear to have been injurious to the future of the town-gas engine, in practice it was not so, as with higher compression (100 to 110 lbs. per square inch) the same size of engine developed an increased power, with a reduction of 20 to 40 per cent. in gas consumption, after taking the reduced heat value into account.

Gas Consumption in Horizontal Engines.

Table A has been prepared to show the gas consumption upon a range of modern horizontal gas-engines up to 105 B.H.P. The consumptions are given for the full, three-quarter, and half loads, which should not be taken as the lowest guarantees which manufacturers will give, but as safe working figures. The table also shows the working cost of town gas per B.H.P. hour with gas varying in price from 10d. to 4s. per 1000 cubic feet; and it should be noted that each engine is assumed to be working upon three-quarter load, as representing average commercial conditions. The figures would be correspondingly lower with the engine operating upon full load.

Comparing the figures in Table A with the results obtained in practice, reference might be made to a series of tests carried out upon an "Industrial" Westinghouse horizontal gas-engine, fitted with variable admission governing gear, at the Neepsend Gas-Works, Sheffield. They are given in Table B.

Table B.

Power	32 max. B.H.P., 30 B.H.P, normal working load
Speed	180 revs. per minute
Bore of cylinder	11 inches
Stroke of piston	19 ,,
Barometer pressure	29·8 inches mercury

Full-Load Test.

Average load during test	29·5	B.H.P.
Total gas used per hour (at 65° Fahr. and 0·75 in. water pressure)	530	cub. ft.
Total gas used per hour (corrected for 60° Fahr. and 30 in. mercury)	523	,, ,,
Cubic feet of gas per B.H.P.-hour = 523 ÷ 29·5	17·7	,, ,,
Heat units per B.H.P.-hour (gas 530 B.Th.U. net value) 17·7 × 530	9381	

Three-Quarter Load Test.

Average load during test	24·7	B.H.P.
Total gas used per hour (at 66° Fahr. and 0·75 in. water pressure)	450	cub. ft.
Total gas used per hour (corrected as before)	443	,, ,,
Cubic feet of gas per B.H.P.-hour = 443 ÷ 24·7	18	,, ,,
Heat units per B.H.P.-hour (gas 530 B.Th.U. net value) 18 × 530	9540	

Half-Load Test.

Average load during test	17·5	B.H.P.
Total gas used per hour (at 60° Fahr. and 0·75 in. water pressure)	360	cub. ft.
Total gas used per hour (corrected as before)	354	,, ,,
Cubic feet of gas per B.H.P.-hour = 354 ÷ 17·5	20·2	,, ,,
Heat units per B.H.P.-hour) gas 530 B.Th.U. net value) 20·2 × 530	10,706	

This engine was guaranteed to have a gas consumption not exceeding 9500 B.Th.U. per brake-horse-power; and after erection it was tested on the site under the supervision of the engineering staff of the Gas Company. With each test a brake load was applied to a special pulley fitted upon the crank-shaft; and the gas value was determined from calorimeter readings taken continuously—the quantity of gas being measured through a standard meter. These tests showed the full load consumption to be below the guarantee, while the three-quarter and half-load tests were equally satisfactory. As Sheffield town gas is sold at 10d. per 1000 cubic feet, the cost of gas works out at the following low figures per B.H.P.-hour: Full load, 0·177d.; three-quarter load, 0·180d.; half load, 0·202d.

The Governing Gear.

The author remarked that one of the most important developments which have taken place in horizontal gas-engines refers to the governing gear. The older "hit and miss" system has been succeeded by "variable admission governing;" and he pointed out that the Sheffield tests were made upon an engine so governed. He gave illustrations showing the general design and application of the system, and emphasized the point that, in order that it might be effective and economical at all loads, "the governor

Table C.

Max. B.H.P. of Engine.	Coal Consumption per B.H.P.-Hour.		Cost (in Pence) of Anthracite Fuel (14,800 B.Th.U. per Pound) per B.H.P.-Hour (Engine Working on Three-Quarter Load), with Coal Varying from 14s. to 44s. per Ton.														
	Load.	Lbs.	14/-	16/-	18/-	20/-	22/-	24/-	26/-	28/-	30/-	32/-	34/-	36/-	38/-	40/-	42/-	44/-
8	Full	1·00																
	¾	1·30	·097	·111	·125	·139	·153	·167	·181	·195	·209	·222	·237	·250	·265	·278	·292	·306
	½	1·60																
10·5	Full	0·95																
	¾	1·20	·090	·103	·116	·129	·141	·154	·167	·180	·193	·206	·218	·232	·244	·257	·270	·282
	½	1·40																
15·5	Full	0 90																
	¾	1·10	·082	·094	·106	·118	·129	·141	·153	·165	·176	·189	·200	·212	·224	·236	·247	·260
	½	1·30																
23	Full	0·88																
	¾	1·00	·075	·085	·096	·107	·118	·128	·139	·150	·161	·171	·182	·192	·203	·214	·225	·234
	½	1·25																
30	Full	0·85																
	¾	1·00	·075	·085	·096	·107	·118	·128	·139	·150	·161	·171	·182	·192	·203	·214	·225	·234
	½	1·20																
35	Full	0·82																
	¾	0·95	·071	·081	·091	·101	·112	·122	·132	·142	·153	·162	·173	·182	·193	·203	·213	·223
	½	1·15																
43	Full	0·82																
	¾	0·95	·071	·081	·091	·101	·112	·122	·132	·142	·153	·162	·173	·182	·193	·203	·213	·223
	½	1·15																
50	Full	0·82																
	¾	0·95	·071	·081	·091	·101	·112	·122	·132	·142	·153	·162	·173	·182	·193	·203	·213	·223
	½	1·15																
60	Full	0·8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1·1																
75	Full	0 8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1·1																
90	Full	0·8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1·1																
120	Full	0·8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1 1																
150	Full	0·8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1·1																
180	Full	0·8																
	¾	0·9	·067	·077	·087	·096	·106	·115	·125	·135	·145	·154	·164	·174	·183	·193	·202	·212
	½	1·1																

should control and regulate a constant mixture immediately at the point of entry into the cylinder." This could, he said, be done by varying the lift of the main admission-valve. He then offered the following remarks on

Producer-Gas Engines.

The main details of the horizontal gas-engine are precisely the same when operating upon producer gas, whether suction or pressure; but as the mean effective pressure obtained from producer gas is less than with town gas, the engine rating is reduced approximately 20 per cent. It is usual to rate producer-gas engines with gas having a net calorific value of 135 B.Th.U. This is an average value for suction gas from clean anthracite fuel. If a mixture of anthracite and coke is used, the heat value of the gas may not be so high, though it is often possible to obtain approximately the same rated output from the engine. When only using coke fuel within a suction-gas plant, an allowance of 5 to 7½ per cent. reduction in engine power should be made.

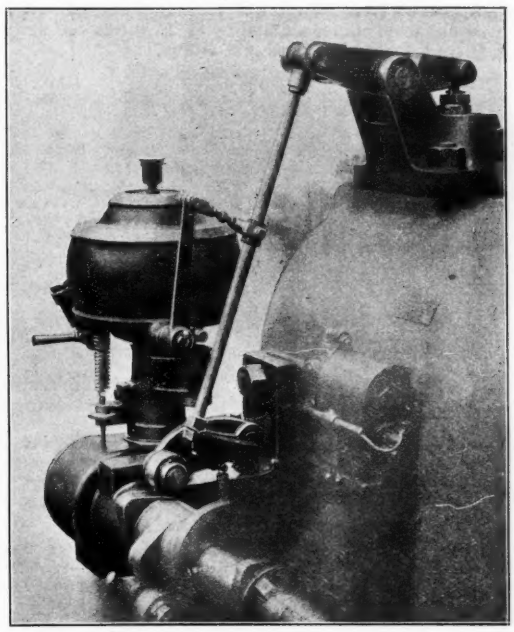
The gas-engine and suction plant comprise one of the cheapest means of obtaining power in this country; but it is not usual (except under special conditions) to instal units below 15 to 20 H.P., as the saving in fuel costs when compared with the cost of working an engine from town gas or oil (in the case of an oil-engine) rarely justifies the increased capital outlay and attendance. Above this power the question of fuel costs per brake-horse-power is the main ruling factor, also taking into consideration hours of working, space available, and convenience. It is quite impossible to adopt any hard-and-fast rule, as each case should be decided upon its merits.

Table C. shows the fuel costs per B.H.P.-hour upon a range of horizontal suction-gas engines up to 180 H.P., using anthracite fuel varying in price from 14s. to 44s. per ton. As with Table A, the calculations are based upon three-quarter load, assumed as being average commercial conditions. Taking as an example a 35 B.H.P. engine working upon three-quarter load, the cost of fuel (using anthracite at 24s. per ton) would be 0·122d. per B.H.P.-hour. Stand-by losses with a suction-gas plant are very small; and assuming the engine operates for 56 hours a week, an addition of 5 per cent. to the total cost of fuel as determined from the figures given would cover these losses under average conditions.

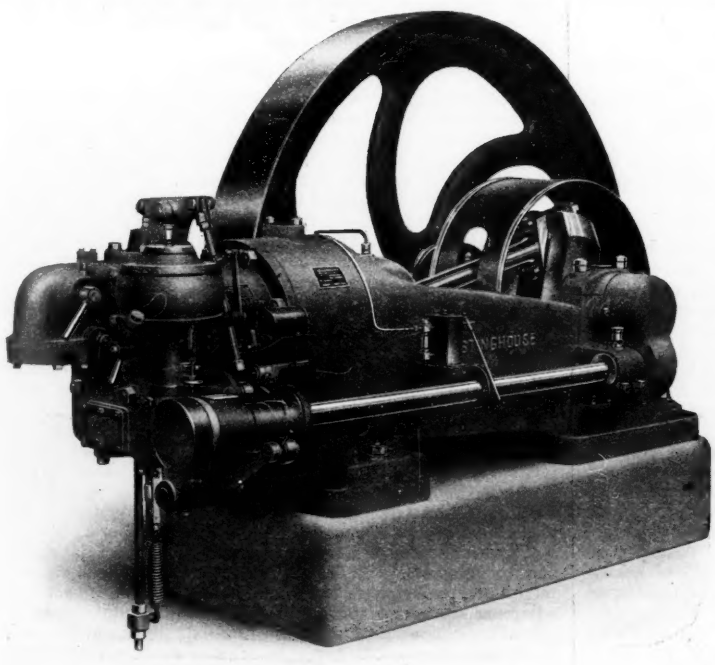
Large Horizontal Gas-Engines.

In this country the large horizontal gas-engine (more than 500 B.H.P.) has not made the same progress as upon the Continent. What are the reasons? In the first place, because more attention has been given there to the use of waste gases from blast-furnaces and coke-ovens, for which these engines are very suitable. The financial interest and control exercised by the banks in industrial undertakings on the Continent have given their engineers opportunities of installing and developing the large gas-engine under very favourable conditions. Apart from these reasons, which apply mainly to the development of the gas-engine in connection with waste gases, coal is cheaper here than throughout the Continent generally; so that in this country the saving with gas power compared with steam power is not so great. The fact that steam practice is older, and therefore better understood, causes many power users to regard steam more favourably, and to consider it more reliable than gas when large power is required.

The exhaust and low-pressure steam-turbine has been a formidable competitor to the large gas-engine in this country, when extensions to existing plants have been required. The addition of a steam-turbine with condensing plant has made it possible to obtain from 30 per cent. extra power (in the case of an existing condensing steam-engine) to practically double the power (in the case of an existing non-condensing steam-engine) without using any more steam, and therefore without increasing the coal consumption. The capital cost for the steam-turbine with necessary condensing plant may vary from £9·6 to £3·6 per additional horse power obtained. Comparing this cost with that of a gas-engine and gas plant of similar capacity, this would be approximately from £8 to £9·5 per brake-horse-power; but the fuel and labour charges are, of course, additional with the gas plant. The conditions are more favourable to gas power when competing against complete new steam plant involving steam-engines or turbines and entirely new boiler-house equipment. Though the large horizontal gas-engine, of the double-acting type, has been successfully built in this country, there are not many British makers, and comparatively few engines have been installed within recent years. Early experience with these engines showed that heat troubles were very considerable, and pointed to the necessity of cylinders and valve-chests being designed with extreme care. The cylinder metal must be uniform in thickness and have a liberal margin of safety to avoid risk of fracture. Prospective buyers were advised to order an engine amply big for the power required; or, alternatively, manufacturers reduced the mean working pressures in the cylinders, and therefore the power ratings upon these engines. This has the effect of considerably increasing the cost per brake-horse-power; so that this type of engine is very seriously handicapped in a commercial sense when in competition with other types of prime movers. At present, it would almost appear that there is a very small demand for these engines; but with the further utilization of blast-furnace and coke-oven gases the demand should be an increasing one.



Westinghouse Variable Admission Governing Gear.



Industrial Type of "Westinghouse" Gas-Engine.

Large Vertical Gas-Engines.

There are now many makers of the vertical gas-engine of the single-acting type, which is constructed with two, three, four, or six cranks. The high-speed enclosed type has been generally adopted. Small and medium sizes present no difficulty; but the power per cylinder, without resorting to water-cooled pistons and valves, is limited to approximately 125 B.H.P. By arranging tandem cylinders upon the vertical engine, units of 1000 B.H.P. are built with eight cylinders —four cranks. Where commercial development of the large horizontal gas-engine has failed in this country, the vertical type has, up to a point, achieved remarkable success.

The advantages possessed by the vertical gas-engine are now fully appreciated, and chiefly consist of their "even turning moment" (especially suitable for electric driving), small floor-space, and moderate installation cost. The British Westinghouse Company were the first to develop the vertical tandem gas-engine in large

powers; but they have not constructed units above 1000 B.H.P. Then the National Gas-Engine Company have within the past few years built a vertical tandem gas-engine having twelve cylinders with six cranks, and capable of developing 1500 B.H.P. It will be seen, however, that these engines soon reach their limitations in power. Experiments now being carried out at the Trafford Park works are in the direction of obtaining improved economy and higher mean pressures, by means of which it is expected to get 150 B.H.P. per cylinder. This will represent 20 per cent. increase in capacity; so that a vertical tandem engine having eight cylinders with four cranks will develop 1200 B.H.P.

Table D gives two examples of actual power costs upon installations of vertical gas-engines. In each case bituminous coal is used, and the gas plants have a system of ammonia recovery. The figures show that the value of the bye-products exceeds the cost of attendance, oil, stores, and repairs; so that the net working costs are less than the bare cost of fuel.

TABLE D.

1.—Actual Power Costs per Annum

For a Westinghouse Vertical Tandem Gas-Engine of 750 H.P., supplied with Producer Gas from a Mond Pressure Bituminous Gas Plant having Ammonia Recovery.

Cr.				*Dr.*			
Tar burned, 75 tons, at 12/3 ..	£45	18	9	Coal, 11,000 tons, at 12/3..	£563	15	0
Sulphate recovered, 32¼ tons, at £13 5s.	438	15	0	Oil for gas-engine £110 2 10			
Oil recovered by filtration ..	17	4	7	Oil for gas plant auxiliaries	2	15	2
				Scrubber materials	1	0	0
				Packing for steam-engines	0	19	6
				Acid for recovery plant	55	0	0
				Repairs, renewals, &c., to engine and plant	5	4	6
				Wages	300	0	0
	£501	18	4		475	2	0
					£1038	17	0
				Less ..	501	18	4
				Net cost per annum	£535	18	8

Figuring at 700 H.P. for 55½ hours per week and 50 weeks per annum.
Total working costs (exclusive of interest and depreciation), 0·066d. per H.P.-hour.

2.—Actual Power Costs per Week

For an Installation of Five Westinghouse Vertical Tandem Gas-Engines, of a Total Capacity of 2300 H.P., supplied with Producer Gas from a Mond Pressure Bituminous Gas Plant having Ammonia Recovery.

Cr.				*Dr.*			
Sulphate recovered, less cost of acid and bags	£14	16	0	Coal, 48 tons, at 12'4..	£29	12	0
Pitch, 2½ tons, at 32/-	4	0	0	Lubricating oil, stores, repairs, renewals, &c.	£7	13	6
Creosote, ½ ton, at 6½d. per gallon..	3	2	6	WAGES—			
Oil recovered and used for other purposes	1	10	0	Chief Engineer and Engine-Room Staff ..	8	4	0
				Gas Plant	3	14	0
				Sulphate Recovery and Tar Still ..	2	2	0
	£23	8	6		21	13	6
					£51	5	6
				Less ..	23	8	6
				Net cost per week ..	£27	17	0

Figuring upon an average load of 1050 K.W. for 54 hours, represents 56,700 units.
Total working costs (exclusive of interest and depreciation), 0·118d. per unit 0·08d. per B.H.P.-hour.

Summarizing the preceding table will give the following results:

	Full Costs Only.		Net Total Working Costs.
1.—Vertical tandem gas-engine, 700 H.P. .	0·07d. per H.P.-hour	..	0·066d. per H.P.-hour.
2.—Vertical tandem gas-engines, 2300 H.P., in five units . .	0·084d. per H.P.-hour	..	0·08d. per B.H.P.-hour.

The author next described and illustrated horizontal paraffin oil and petrol engines, and then offered the following remarks on

DIESEL ENGINES.

A few years ago the claims of the Diesel engine were brought very prominently under notice. The advantages offered by a prime mover consuming crude fuel direct, without the aid of auxiliary apparatus (such as the steam-boiler in the case of the steam-engine, or producer plant in the case of a gas-engine), were at once apparent to the power user. The saving in floor-space, reduced attendance, and absence of all stand-by losses, were other advantages not to be overlooked. As a result, a considerable number of Diesel engines were installed for electric lighting and industrial purposes throughout the country.

It is a well-known fact that this engine has a higher thermal efficiency than any other type of internal-combustion engine, and the fuel consumption per B.H.P.-hour upon one of approximately 200 B.H.P., when using crude oil containing not less than 18,000 B.Th.U. per pound, may be taken as follows: Full load, 0·46 lb.; three-quarter load, 0·48 lb.; half load, 0·55 lb. When crude oil could be purchased at about 40s. per ton, the Diesel engine was a most attractive proposition, considered from the question of fuel costs. Unfortunately, crude oil has advanced in price considerably (in some cases to upwards of 90s. per ton, as Diesel engine users know to their cost); the present price of American crude oil in Manchester being approximately 65s. per ton.

Table D will serve to make a commercial comparison of fuel costs per B.H.P.-hour, according to the price of oil fuel. The calculations are based upon three-quarter load working with a fuel consumption of 0·48 lb. per brake-horse-power:

TABLE D.

Cost of Crude Oil per Ton.	Fuel Cost per B.H P.-Hour.	Cost of Crude Oil per Ton.	Fuel Cost per B.H.P.-Hour.	Cost of Crude Oil per Ton.	Fuel Cost per P.H.B.-Hour.
s.	d.	s.	d.	s.	d.
40	·102	60	·154	80	·205
45	·115	65	·167	85	·218
50	·128	70	·180	90	·230
55	·141	75	·192	95	·244

Manchester is a favourable centre for obtaining crude oil in bulk; but where supplies in bulk are not easily obtained, the prices are higher.

A comparison between the fuel costs upon a Diesel engine and upon a suction-gas plant and engine is generally in favour of the latter. In Manchester, good Welsh anthracite fuel varies in price between 18s. 6d. and 29s. 6d. per ton. Taking the average price of 24s. for suitable fuel for a 60 B.H.P. gas-engine working upon three-quarter load, the fuel costs would be 0·115d. per B.H.P.-hour. With gas-engines of upwards of 100 B.H.P. using bituminous coal at the gas plant, the fuel costs would be very much less.

Though, after starting-up the Diesel engine, no attendance is required as with the gas plant, much more skilled supervision is needed at the engine. Valve-grinding must be attended to regularly; and it is vital to the safe working of an engine that this work is never neglected. A leaky fuel-valve causing pre-ignition may develop enormous strains within the cylinder, and be the the cause of a cracked piston or cylinder head, or even of a broken crank-shaft. On the other hand, leaky valves upon a gas-engine are not likely to affect its safe working. A gas-engine (whether working on town or producer gas) can run with perfect safety and yet have leaky valves. The only disadvantage would be a slight falling-off in economy, and in very bad cases a possible decrease in power.

These are important points in considering the Diesel engine as a commercial proposition; and they are not intended to reflect upon its merits. There are conditions under which it pays to provide the special attention required, as, for example, on board ship, in countries where crude oil is cheap compared with solid fuels, and as stand-by plant.

THE SEMI-DIESEL OIL-ENGINE.

The semi-Diesel engine development is the outcome of the commercial demand for small and medium-power oil-engines which will consume as fuel cheap crude and residual oils. Progress has been very rapid, and already there are signs of this type of engine being developed in large sizes, and thus becoming a serious competitor to the Diesel engine. The fuel economy of the engine may not be quite so good as with the Diesel; but this difference is very small. On the other hand, the engine is simpler in construction, the working temperatures and pressures are much lower, and the attendance required is ordinary.

With the Diesel engine, combustion occurs from the heat of compression. This involves pressures of 30 to 35 atmospheres, adding considerably to the difficulties and cost of starting arrangements. With the semi-Diesel engine the compression pressure is not carried so high, and ranges from 160 to 250 lbs. per square inch. Starting is by hand for engines up to about 20 H.P., and above this size the ordinary and inexpensive system of compressed air starting can be used.

CHOICE OF POWER.

Notwithstanding the many improvements made upon internal-combustion engines, there remains in some cases a certain amount of prejudice against their adoption; and not unfrequently a prospective power user has difficulty in deciding upon the class to adopt, owing to much conflicting evidence. The economy of the internal-combustion engine is generally admitted; but the merits claimed for any particular type should be carefully stated and not exaggerated, as each type has its limitations. In the past a certain amount of injury has been done to this engine by claiming too much.

Peat Gas and Products Works in Italy.

Now that the regions of Mantua and Ferrara have been drained, it has become possible to work the peat bogs below sea-level. A company has accordingly been formed, and works erected, for the production of gas and the recovery of residuals by the Mond process. According to a description in the "Monitore Tecnico," two bogs, one 1730 and the other 1235 acres in extent, are being worked. The thickness of the bed of peat varies from 1 ft. 8 in. to 3 ft. 3 in. After being dried, the peat is carbonized in six retorts, the capacity of each being 30 metric tons per 24 hours, with a daily production of about a million cubic feet of gas having a heating value of 155 B.Th.U. per cubic foot. At the same time 120 quintals of sulphate of ammonia are obtained. There are also adjoining works for the manufacture of the sulphuric acid required for making the sulphate. Large quantities of tar are also produced. The works cover an area of 22 acres. The results are stated to have been satisfactory, from both the technical and the financial point of view.

MANCHESTER JUNIOR GAS ASSOCIATION.

University Lecture by Mr. Leon Gaster.

The Second University Lecture of the 1914-15 session in connection with the Manchester and District Junior Gas Association was delivered in the Organic Chemistry Theatre of the Manchester University on Saturday last by Mr. Leon Gaster, entitled "Illumination and the Illuminating Engineering Movement."

The PRESIDENT (Mr. J. M'Nichol, of Warrington), in welcoming the lecturer, said he was sure that most of the members were already well acquainted with him through the columns of the Technical Press. Their visitor had kindly furnished him with a quantity of printed matter dealing with the question of illuminating engineering; and this he would be glad to distribute at the close of the lecture.

Mr. GASTER afterwards delivered his lecture, illustrating not only the nature and aims of the Illuminating Engineering Society, but subjects relating to the science and art of illumination both in theory and practice. A report of the lecture will be found on p. 538.

EXCELLENCE OF MANCHESTER STREET LIGHTING.

The lecturer prefaced his remarks by congratulating the Manchester authorities on the excellence of the street lighting which he had seen, and said he was glad the City Fathers had given the two illuminants, gas and electricity, the opportunity of showing their best. This was a good deal more satisfactory than sending a deputation to different municipalities to inquire into the street-lighting question. He thought Manchester scored heavily in this respect.

At the conclusion of the lecture,

The PRESIDENT observed that though Mr. Gaster had expressed his willingness to answer any questions in regard to it, the information had been so complete that he could not imagine they would have many to put.

Mr. R. NEILL (Bolton) moved a vote of thanks to the lecturer. He said the small attendance was, in part, due to the military situation; but when absent members read the lecture in the Technical Press they would be sorry not to have had the opportunity of hearing it. It had proved one of the finest lectures they had had since the University series was started.

Mr. J. ROBINSON (Altrincham), who seconded, said the lecturer had taken into consideration every aspect of the illuminating question—the home, the workshop, and the office. It showed them that the lighting question had not yet been sufficiently tackled by many gas undertakings. He would welcome more lectures on similar lines.

The PRESIDENT said he agreed with what had been said. The racy style—if he might allude to it as such—and breeziness of the lecturer were much appreciated. There was no doubt that they had been privileged to hear a very "illuminating" lecture.

Mr. GASTER, whose rising to acknowledge the compliment was received by acclamation, thanked the members for the patient and courteous hearing they had given him. He assured them that it was a great pleasure to be there that afternoon, and hoped that everyone present would spread the intelligence, and so become an illuminator. The amount of good they could accomplish in this respect was enormous.

EFFECT OF FROST UPON CONCRETE.

The carrying out of constructional work in Canada during the winter was dealt with in a paper submitted last Tuesday to the Institution of Civil Engineers, by Mr. J. HAMMERSLEY-HEENAN.

The author said that, as a result of considerable experience gained during the last few years, it can be stated that the freezing of concrete will not damage it, if it has first had a chance to set under favourable conditions for about two days. The effect of the freezing is simply to delay the process of hardening, which will again proceed under suitable conditions, and will eventually attain its full strength. If concrete is frozen before it has commenced to set, it will not be injured if precautions are taken to prevent it from freezing again after it thaws until it is sufficiently hardened to withstand the effects of subsequent freezings. It is alternate freezing and thawing during the process of setting which causes the damage. For light sections of concrete—such as in reinforced concrete—poured at a temperature not below 22° Fahr., some engineers allow salt to be used in a proportion not exceeding 10 per cent. There are many arguments for and against its use. The author prefers not to employ it, except in marine works when the concrete is mixed with sea-water, and the salt is admitted in this form. He has found that, instead of using salt, good results will be obtained for temperatures that do not fall below 22° Fahr. by heating the water with a steam-hose taken from the mixer-boiler, and when necessary placing a few coke or wood fires on the heaps of sand and crushed stone; the usual precautions being taken to protect the concrete when in the forms. For lower temperatures than these, greater precautions must be taken to heat the ingredients by means of steam-coils or radiators.

There are many examples of concrete works which have stood the test of time without showing any signs of being affected by frost; but, on the other hand, a few cases have been reported of very serious corrosion due to the action of frost—such as bridge-piers and reinforced concrete piles. Judging from the information available at present, concrete exposed in air in a dry locality need not be affected by frost any more than good building stone, and probably it will stand much better. Concrete always submerged under water is protected, and need cause no anxiety. But concrete alternately wetted and frozen must be protected from frost.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

A Meeting of the Scottish Junior Gas Association (Western District) was held in the Royal Technical College, Glasgow, last Saturday—Mr. DAVID FULTON, the Vice-President, in the chair.

THE ASSOCIATION'S ROLL OF HONOUR.

The CHAIRMAN, at the outset of the proceedings, stated that the Roll of Honour of those serving their country contained 17 names, which he thought was very creditable to their Association. The name of any member not yet included should be handed in to the Secretary.

ARRANGEMENTS FOR A VISIT.

It was left in the hands of a Sub-Committee to arrange for a visit between this meeting and the next meeting, on Feb. 6. The Council felt that during such a long interval, there was a possibility of the members getting out of touch with the Association.

Mr. ALEX. WRIGHT (Lockerbie) then read the following paper—

EXPERIENCES IN SMALL GAS-WORKS.

When I was asked to contribute a paper for this session, I at first hesitated, but then thought I might try and give some of my experiences in small works.

DESCRIPTION OF THE LOCKERBIE GAS-WORKS.

The Lockerbie Gas-Works are fairly modern. It is only about seven years since (or in 1907) that they were remodelled and fitted with the then latest appliances. The works are situated at a very convenient place, at the foot of the town. The new retort-house and coal-store, 64 feet by 34 feet inside, is built of red sandstone from the well-known Corncockle Quarries, which are quite near Lockerbie. The front side of the house is panelled and built in rock-faced rubble; the windows and doors being all arched, giving the building a fine appearance. The coal-store is capable of taking 250 tons of coal, or about nine weeks' supply, when well built-up.

The retort-bench is built entirely free from all walls, and is bound in cross section by vertical H buckstays front and back, with horizontal cross girders connecting the front and back buckstays, and tie-rods from the end buckstays fitted with coupling boxes. The bench consists of two ovens of six retorts each and one oven of four retorts. The latter oven is capable of setting six retorts, should this ever be necessary. The settings are Waddell's and Hislop's patent shallow regenerative, and Brown's patent shallow regeneratives are about to be set.

The hydraulic main is supported on cross girders which run horizontally from the front to the back of the retort-bench, and is divided into three sections, one for each bed of retorts, each section having a gas and tar off-take. Clean water or ammoniacal liquor can be supplied to each section by means of a pipe running along the front of the hydraulic main. This is very convenient, as the main can be flushed out at intervals, or there can be a continual flow of liquor through the hydraulic main, which can be supplied from the scrubber overhead tank.

A Scott's patent travelling table takes the place of the usua plate-flooring.

A vertical Cochrane boiler is placed in the retort-house; the cast-iron chimney passing up through the roof. The boiler is used for supplying steam for the producers and driving a Tangye pump for raising tar or liquor from the well and providing steam during frost.

A water spray for quenching coke, and a dirt and silt trap are just outside the retort-house door.

Steel annular condensers, capable of dealing with 80,000 cubic feet of gas per diem—consisting of two columns, 21 inches diameter outside and 13 inches diameter inside, by 20 feet high—are placed outside the retort-house.

A 3 B.H.P. gas-engine is used for driving, by means of pulleys and belts, a shaft, which in turn drives the Waller two-blade exhauster, a small centrifugal air machine for supplying air, through a meter, for revivification *in situ*, and a liquor pump, which lifts liquor from the well to the overhead tank of the scrubber.

The scrubber is one of George Bower's. It has been for a number of years at work, but operates very satisfactorily. It is a tower scrubber, with overhead tank for liquor or water, which passes down through a syphon into the scrubber proper and washes the gas.

There are two purifiers on Green's luteless principle, with rubber bands, and two with water lutes. The four are 8 feet square by 3 ft. 6 in. deep inside, with two tiers of wooden grids. They are all under one roof, and can be worked in any rotation.

A small underground tank used as a tar and liquor well, and covered with strong concrete, gives a fairly large area for working

on. This space is mostly used for revivifying oxide of iron. An overhead tank, 9 ft. by 4 ft. by 4 ft., is erected on two brick piers built on top of the well. The tank is filled with liquor by a Tangye steam pump delivering 800 gallons in 15 minutes; an overflow going back to the well. A cart barrel is filled from the overhead tank by means of a valve in front of the tank, and carted to a railway tank waggon. Ordinary tar barrels are filled from below by means of a pipe fixed to the bottom of the overhead tank, with a stopcock at convenient height.

The storage capacity is ample; there being two gasholders —one of 14,000 cubic feet capacity, the other 22,000 cubic feet. The large tank is built on the surface, owing to the boggy nature of the ground. It is thereby exposed to the severe influence of frost, and the water freezes very quickly. The small tank is partly above the surface of the ground.

The station meter is one of Alder and Mackay's 600-light, of 3600 cubic feet per hour capacity, with 30 cubic feet per revolution—a round type, with four-way cock and cradle.

An Old Pump.

In looking up some papers I came across a description of an old pump, which was of such antiquated nature that I think it worth mentioning. It was simply a tree trunk, 14 inches in diameter by 22 feet long, with a 4-inch hole bored through the centre the full length, having two 4-inch holes from the outside to the centre and about 9 inches from the end. The bottom hole was the suction, where there was a foot valve, and the other was the delivery, which stood about 10 feet above the top of the tank. From a raised platform, and by means of the usual pump handle, two men pumped the tar and liquor. It was hard work to pump 200 gallons in 25 minutes.

Early Experiences.

In taking up my duties as Manager, I was informed that the oven of six retorts in use was a badly heating one. I set about to try and find the cause, and get it remedied if possible. On entering the retort-house one morning I was surprised to see the whole fire lying in the ashpit. The stoker was cleaning the fire, and had drawn the fire bars out altogether. The fire door and ashpit door were wide open, and the producer was getting quite dark. I asked if there were no false bars, and was told that there were, but they were of no use. I told the stoker that use would have to be made of them. In a few mornings, by the use of the false bars, with less steam (as they had been using an excess) and much easier work for the stokers, the heats, which had been very low for a long time, began to show a regular brightness that ought to have been in the setting all along. The result of the heats being allowed to rise and fall proved very detrimental to the retorts, which were all cracked and had fairly large openings showing. The result of this is quite well known—gas going up the chimney. Then the carbon in the retorts was very thick, not having been scurfed for over ten months—so I was told. It was acting as a baffle, and so assisting in the work of waste. We set to work to get the carbon out; but I had difficulty in convincing the men that it could be taken out when hot. I got it out of one myself, and then, by a little perseverance, we managed to get them all cleaned and the cracks patched in the five. In the sixth was a hole about 20 inches in length by 9 inches wide, which had lain for over two months; but the retort was perfectly clear of carbon, which had all been burned off. We got the hole repaired, and the retort charged again. This retort gave us no trouble until the setting was let-down at the end of the next summer. The setting was working practically a year longer than was expected, as the new setting was to have been on at the beginning of the winter when I took charge in October, but was not ready until after the New Year.

When the old setting was taken out, we found the air-flues were very badly choked with dust—a 2-inch space in place of 9 inches, owing to the manner in which the flue was built. The air inlet to the setting was next to the fire, and took a right angle turn to the wall of the arch, then a straight turn to the back of the setting; but no means of cleaning out this flue were left. However, the setting is being replaced at present.

We have been getting very good heats without the use of steam in Hislop's patent regenerative setting. This has resulted in a great saving of coke, but causing another trouble—an increased stock of coke, though we have sold about 90 per cent. more coke this year as compared with last. We are much handicapped by the want of screening plant, as the bakers (who use a fairly large amount of coke during the year) get most of their supply from Glasgow, although we have riddled it well for them. For greenhouse purposes, however, the consumers are well pleased.

Periods of Carbonization.

I have tried the various periods of carbonization—viz., 6-hour charges with about 3 cwt. of coal; 4 hours and 48 minutes charges with 2½ cwt.; and 4 hours charges with 2¼ cwt. I find the best results are from the 4 hours and 48 minutes charges.

Works Troubles and their Remedy.

We have only once had a choked ascension. This was through a stoker not using the auger regularly. But we had little difficulty in getting it cleared. About six months ago we had a complaint from the Burgh Surveyor about dirt and silt from the coke quencher being lodged in the main sewer, which passes through the works, thereby causing a stoppage. We built a sand trap of bricks, 2 ft. 6 in. square by 3 ft. 6 in. deep, from the grating to the bottom of the trap inside, with a bed of concrete and a concrete surface for the hard wear of coke-barrows, and a 4-inch inverted right angle fire-clay bend as a water take-off; so that now the dirt and silt collect for 2 feet, and are then cleaned out. The old system was just a bell-trap fixed on top of a 4-inch fire-clay pipe; but the bell was as often off as it was on. Hence the reason of the stoppage. The silt had grown round the pipe till about 1 inch space only was left for the water to get clear.

I had a considerable amount of trouble with the gas-engine, as it was not working properly. I took out the valves, which badly needed grinding, also the piston. There were two rings broken in the latter, and it was seriously clogged with carbon. The face of the piston socket had been split by trying to drive the piston in with a heavy hammer. A ring, 1-inch broad, had been shrunk on to the liner, which has made a very good job; making it look as if it were part of the engine. The engine is now working very smoothly. The gas supply to the engine is taken from the outlet of the station meter; and should the exhauster ever be pulling too much, and drawing in air or furnace gases, it soon affects the gas-engine, which will stop if the gas becomes bad—thus acting as a tell-tale.

We have twice had experience of the gas being bad—caused by the stoker putting weights on the governor and thus causing about 2-inch vacuum, which stopped the engine.

About 5 o'clock one morning I was aroused by the stoker, who informed me that the purifier-house was filled with smoke. When I got to the shed I found a slight fire had been kindled, caused by the oxide of iron which had been taken out of the purifier the previous day and been placed in a heap inside the shed, owing to the weather being very wet when the purifier was emptied. We usually lay the oxide out in the open; but owing to it being in a heap, it had caused spontaneous combustion, and set fire to an old wooden press, which was slightly damaged. Fortunately, however, the fire was easily quenched by a few buckets of water. We were also fortunate in having all the purifiers and connections closed at the time. I have since been careful not to put in the shed oxide newly out of the box. While speaking of oxide, I think it should be under cover, as it is liable to get too wet when placed in the open. When I took charge at Lockerbie, the oxide was so wet that we could not get enough in a condition to fill the purifier. We had to place it on the retort-house floor in thin layers for a few days before we could use it.

I have tried the clean box last in a series, also putting it first, and think the latter way has the advantage over the former. Our boxes are set with the inlet at the bottom and the outlet at the top. I believe the gas passing in at the top prevents back-pressure to a greater extent than by the former method. I have thought of altering the inlet to the top, as we have been occasionally troubled with back-pressure. When the box was emptied, the bottom layer of oxide was quite hard for about 4 or 5 inches. Sometimes it was necessary to use a pick or pinch-bar to break through the mass, and we found an inch or two of liquor had collected in the bottom.

In one of the water-lute purifiers there were only two clamps, which were bent T-rods, to fasten under the outside edge of the lute. One of these clamps became loose when the box was in use, causing gas to blow at the lute. After that I had two screw clamps made for the other two sides, and now the lid cannot move.

We had some trouble with a stoppage in the outlet pipe from the exhauster; some crystals having collected at the bend, which was very difficult to get at. However, I got the bend bored and tapped, so as to get a wire in at top and relieve any stoppage that may take place there again. At the same time I cleaned out the exhauster and the non-return-valve in the box above. When all was cleaned and fixed up again, the exhauster would not get a vacuum. On going back to the non-return valve, it was found that in putting on the valve a small piece of hard putty had fallen in front of the valve and prevented it from closing. This was taken out, and everything has worked very well since.

In the station meter the only method of watering was by means of pails—a very slow process. So I fixed a pipe from the water service and a stopcock and bent pipe to the water inlet; and now we have only to turn the tap and get the meter watered in a very short time, or we can leave the water dripping, and thereby keep the water-line always right, which is very important for correct registration.

One benefit we have in connection with the two holders is that no changing of valves is required. When the large holder empties itself, the small one takes up the supply, or, *vice versâ*, when they are being filled the small holder fills first and then the large one. A 6-inch main passes from the small holder along the front of the large holder, and is connected by the outlet pipe to the 8-inch main from the large holder. The 8-inch main is connected to a Braddock's two-valve governor, thence to the main. The small gasholder has chain weights hanging from pulleys on top of the pillars. When going round this holder on my arrival in the works, I found a number of holes in the bottom plates which I got repaired. One of the holes was fully ¼ inch in diameter; and gas was blowing from this and a few others. The holder could almost swing out of the water, and did so when the wind was strong, as the weights were far too low. I therefore had brick piers built as rests for the weights; and now there is no fear of any gas escape, as the holder is much firmer.

The large holder gets badly discoloured through the oxide of iron being revivified close to it, and the water contaminated with

the oxide. The holder was painted a dark slate colour, and is now quite yellow.

The governor refused duty one day, and stuck fast—fortunately when the valves were open. On examining it, I found it was covered with earth, and had neither valves on the inlet nor the outlet. I had to bore and tap two 1¼-inch holes for the reception of rubber bags, so as to shut off the gas until it was repaired. On the 6-inch pipe there is a valve which acts as a bye-pass. This valve had been shut off.

I have placed meters in different parts of works, so as to get a proper account of the gas consumed, as I think it is a bad system to calculate the quantity of gas used on the works, which might be too high or too low, and which also prevents one from getting at the actual unaccounted-for gas. I am pleased to say this has been reduced according to the survey of meters just finished for the half year, as our sales are up over 200,000 cubic feet; so we are on a different footing to most towns, especially those on the coast. I attribute the increase to the use of cookers, gas-fires, and new consumers (which I may say since I came to Lockerbie have increased about 17 per cent.).

Distribution.

Distribution is as important a factor for the economical and successful working of a gas department as is the manufacture and purification of gas. The latter may be regarded as the primary operations; but the former is not less important. It has been said that the retort-house is the place where the money is made; but if the money is wasted on distribution, it is no benefit to the gas concern. The two departments must work harmoniously to make the concern pay.

Tact in Dealing with Consumers.

I think a great deal can be done to foster or mar the sale by the individual who is in the district. One man may be the means of bringing many consumers to see the use of the various methods of using gas; while another may be the means of discouraging the consumer by scarcely being civil. From my experience, the best way is to listen to the complaint or request, and try to help the consumers out of their difficulties by showing them the best way to act. If time does not permit just then, I make an appointment; and I always do my best to keep my appointment. I find consumers are very willing to take advice. Advice is often the means of more business, or perhaps a new consumer. A very common complaint is that the gas account is too large, and the consumer perhaps wants a cooker taken away. By a little patience, however, I have managed on many occasions to get consumers to retain the cooker by showing that the account was not so large as they thought—by taking the number of days they were using it from the last account, and then showing them how much they were paying per day. This generally convinces them that all is well. One instance that I had last year was a consumer who thought she was paying too much, and sent word to us to take away the cooker. I went and asked her how much she would consider reasonable to pay per day; and when I told her she had only used half what she considered cheap, she kept the cooker. I may say that she has consumed about £3 worth of gas in less than a year since then.

Another complaint is bad gas, which generally turns out to be due to improperly regulated or dirty burners. I usually carry my tools and pamphlets of gas appliances in my pocket, and find it is very convenient, as at times people ask about a gas-fire or a cooker, and when you can give them the information an order is usually obtained.

When on the meter survey, I pay particular attention to those meters which seem to be decreasing in consumption, and try to find the reason (if any) and get it remedied. If the meter is not working properly, then get it replaced (which usually pays well). Complaints as to deficiency of gas should always be attended to at the earliest possible moment. If the service is at fault, then get it cleared or renewed. Often the real cause of complaint is the consumer's own fittings. Sometimes it will be found to be due to the pipes being too small, or to cheap burners, which are very often the cause of complaint. The consumer should be made to understand that he must have these attended to himself. The consumer will want a great amount of work done if the gas department is to do it, but usually wants as little as possible if he has to pay himself.

Laying a New Main.

Owing to several complaints, we had to undertake the relaying of new mains in two streets. After consideration of the various types of pipes, it was decided to lay a 3-inch steel main in the streets, which were not very long and with blind ends. The old main was of 1½-inch and 1¼-inch cast iron, and was laid in random lengths, some very short, which entailed a large number of joints. The Gas Committee thought it best to give out the contract for laying. The pipes were Mannesmann steel tubes, covered with jute cloth, and coated with their special mixture. They were in lengths averaging 27 feet, of about 10 W.G., with ordinary joints. The pipes having arrived, we set to work and got the old main bored and tapped—1-inch and 1¼-inch for the connections for 1-inch iron pipe laid temporarily, and the other hole for bagging the main and for the use of Milne's patent gas-main stopper.

The pipes were laid on tressles, and three were jointed by means of lead wool and yarn staved well in, and then caulked by means of a heavy hammer. The sections were then lowered into the trench and jointed-up to the existing main by means of a reducing piece—5 inches to 3 inches. Milne's patent gas-main stopper was inserted into the new main before jointing to the reducing piece. When the first joint was made, we took out the rubber bag, and then drew the stopper along the main till it was seen at the open end of the pipe, and continued the process of jointing three on the top of the trench and lowering and jointing and drawing the stopper along. When we came to the services, we jointed them before the stopper was drawn (making sure the arrows inside the hole were filed away before fixing the knee or bend as the case might have been). The services were connected by means of malleable iron clamps and bolts with lead washer and white lead, taking care to have the bolts thoroughly tightened. Some of the old services were badly pitted when taken out. The main was tested by means of the greatest pressure we could obtain from the holder.

I tried to obtain the loan of a testing apparatus, but was unsuccessful. To have bought one would have been rather expensive for the short length of main being laid. However, I think by means of the pressure from the holder and using soapy water, we have had a fairly good test. By the use of Milne's stopper we were ensured that nothing could be left in the main; also that the air was all drawn out in front of the stopper and gas drawn along at the back of it. The stopper gave us every satisfaction. There were about one-fourth the number of joints in the new main as compared with the old one. This should ensure a reduction of unaccounted-for gas, and we hope to have no more trouble from these two streets for a number of years to come. We obtained a few fresh consumers through the new mains being put in.

One thing I do not care for in Lockerbie is that we charge for meters. It is not a large rental, but I think it is objectionable. However, we hope to have this taken off soon. The gas has been reduced by 5d. per 1000 cubic feet within the last two years, although the coal had been increased by about 20 per cent., but is reduced again by about 7 per cent. This year we hope to be in a position to reduce the price of gas a little.

In conclusion, I say that the Lockerbie Gas-Works is one of those works which gradually grows every year, as it has done since being taken over by the Town Council in 1892—the Council having adopted the Burghs Gas Supply Act in 1891. The price of gas then was 6s. 8d. per 1000 cubic feet, and the make 2,277,000 cubic feet. In the year to May last the price was 4s. 7d. for light and 4s. 2d. for cooking, heating, and power, and the make 9,874,500 cubic feet.

DISCUSSION.

Mr. J. S. M'Nicol (Dawsholm), opening the discussion, remarked that Mr. Wright had mentioned that the present gas-works at Lockerbie were fairly new, dating from 1907; yet they had installed a two-blade exhauster. He would have thought that the installation might have commanded one of three blades. He inquired of the author if he did not think he would have been better advised to drive the exhauster by steam instead of a gas-engine. Dealing with the reference to cracked retorts, he asked if the carbon did not cover up the cracks, and so prevent the wastage of gas. It had also been stated that with Hislop's regenerative settings there was a great saving of coke. Was there trouble with clinkers? He fancied that the coke made in small works like those at Lockerbie would be much better than that produced in the large works in Glasgow, where they had mixed coals. He would like an explanation as to why the Lockerbie consumers preferred Glasgow coke.

Mr. A. Paterson (Glasgow) said it was not necessary for Mr. Wright to use rubber bags for the reception of gas while the governor was being repaired. He should have got hold of a bullock's bladder.

Mr. J. B. Stewart (Glasgow) remarked that he should like to have undergone the experiences through which the author had passed. Mr. Wright had said they had a different price for gas used for cooking. Had they two meters—one for cooking and one for lighting?

Mr. John Wilson (Falkirk), dealing with the question of coal storage, remarked that nine weeks' supply was rather little nowadays, in view of the possibilities of strikes. Mr. Wright had said that in one setting he had a saving of coke by stopping the use of steam. How did this come about? He failed to see why it should be so. If one stopped the supply of steam, the tendency was that more coke was burned. Did the author think that steel annular condensers were effective? He (Mr. Wilson) was not too favourably disposed towards them. He thought they should be dropped out of gas-works practice. They were not efficient. As to the holder water freezing in the tank above the ground, how did this compare with that which was partly submerged? Was there any difference? What was the author's method of getting rid of the carbon from the retorts? In regard to meter-rents, was a manager to do the best for himself or the best for the undertaking? Meter-rents meant cheaper gas; rents for cookers meant cheaper gas; and so on. All these little extras that were charged for meant that the price of gas was less; whereas if free meters, free cookers, free maintenance, and free advice were given, it meant slightly dearer gas. But was it not more advisable to supply a little dearer gas, and do without meter-rents, &c.?

Mr. J. Jamieson (Thornliebank) thought that the Lockerbie coal supply of nine weeks was a very generous provision. His storage capacity was only equal to a two-weeks' supply. As to purifiers, he could fill boxes in the summer that would run to the next summer. They got them to run for nine months.

Mr. Malcolm Littlejohn (Glasgow) wished to know if the

author had tried at any time putting salt into the water to prevent it freezing. Did he supply gas for street lighting; and, if so, what price did he charge?

Mr. A. CUNNINGHAM (Bridge of Weir) differed from the author's view of the revivification of the oxide. He (Mr. Cunningham) let his lie out for two months before he used it again. He did not think it took up too much moisture. With regard to the exhauster, they used steam. They had an arrangement by which a gas-engine was used when the steam-boiler was off for examination. They had dispensed with meter-rents and cooker hiring; and this had done good. They used to put out a meter with the cooker. Then they reduced the gas to one level—4s. per 1000 cubic feet.

Mr. FRASER said one point which had appealed to him in the paper was the reference to the two holders. Brick piers had been built, on which the weights rested in the smaller holder; but this would make the holder the heavier one, and it would fill the big holder. On the subject of the patching of the retorts, did Mr. Wright use a special class of brick and cement?

Mr. WILSON, speaking again, said Mr. Wright had stated that he had sent his gas in at the bottom and passed it up through the purifiers. He would be well advised to put it in at the top. As it was, Mr. Wright found that with his boxes with the inlet at bottom and the outlet at top there was produced a bottom layer of oxide which was very hard and stiff. This was brought about by his admitting air for revivification purposes. The more revivification that took place, the harder would be the layer at the bottom. He also found gas liquids at the bottom of the box. If he passed the gas down, this liquor would permeate the whole mass. He would find a much smaller quantity of gas liquor in the bottom of the box when he took it out.

Mr. D. FULTON, in closing the discussion, said he had had the pleasure of seeing the Lockerbie works. On the occasion of his visit, Mr. Wright had mentioned that the travelling table had its disadvantages as well as its advantages. What were the disadvantages? He was sure the Glasgow people must be surprised to hear such a testimonial to the quality of their coke. Price did not seem to enter into the matter. He believed he was right in saying that in small works the practice was to load the coke with forks. He thought Mr. Wright should push the bakers. Once they had tried his coke, Glasgow would be out of it. One point in the paper had specially appealed to him. Mr. Wright had spoken of trying various periods of carbonization, and found the best results were obtained from the 4 hr. 48 min. charges with 2½ cwt. of coal. This meant that in 24 hours he had five charges equal to 12½ cwt., which, taking his make at 10,000 cubic feet per ton of coal, gave him 6200 cubic feet per mouthpiece. He ought to do better than this. The remarks about water for the station meter raised the point of the examination of the meter. It was one which was greatly neglected in small and medium-sized works. The station meter should be examined at intervals. If it was not correct, the unaccounted-for gas could never be calculated. He had not had any experience of laying steel mains; but 82 feet at a time seemed a good length. Regarding meter-rents, it seemed to him unfair that any company or corporation should charge a rent for the instrument which measured the quantity of gas consumed. It was not right or fair that there should be meter-rents. In Lockerbie there was a differential rate. He considered it was much better to foster the use of cooking and heating appliances by charging as low hires as possible and having a flat-rate. He thought Lockerbie had taken a grant from the rates to cover the cost of the purchase of the works from the Company. This had seldom been done in Scotland, and he should like to get some information on the point.

Mr. WRIGHT, replying generally to the discussion, said that in the works with which he had previously been connected they had no exhauster. If there was the least crack, and there was carbon over it, there nevertheless was waste, as the gas went through the carbon and crack. As far as the use of steam was concerned, Mr. Hislop stated that the setting could be used with or without steam. It was only an occasional time that the clinker was bad. It depended upon the class of coal. They tried to get coal for the fire that was least liable to produce clinker; and they used three or four different classes. The bakers had in the first instance gone to Glasgow for coke, not because it was better, but because they could not get a regular supply at Lockerbie. In Glasgow they had it riddled and of a certain size. In Lockerbie they would require a coke-breaker; and coke-breakers meant money for an extra man. As regards cost, the baker getting coke from Glasgow had to pay carriage of 25s. a waggon. They in Lockerbie up till lately sold coke at 13s. 4d. a ton; and last year every particle was sold. Since then they had been completely choked up. They had reduced the price to 12s. to get it away; but only one individual came in for 6 cwt. With regard to Mr. Stewart's question as to whether they had two meters, they had one for the cooker and one for the light. He thought it a very expensive thing to have. It cost them upwards of £100 for meters alone. He considered one rate was the best. He had found their annular condensers worked all right; but he believed that horizontal ones were even better. Referring to the questions regarding the getting rid of the carbon, Mr. Wright said he had taken it out of the retort himself, as the stokers did not think it could be done. He agreed that the gas company ought to pay for the meter which registered the gas, as it was for their benefit and not that of the consumer. He might explain that the retorts had been patched with their ordinary bricks. Silica bricks, which stood a high heat, were easily broken. They used two forks for loading the coke; and the breeze was taken out and put on the footpaths of the country roads, or plasterers used it for deafening purposes. Mr. Fulton had spoken of the length of the charge. They had at times to work with five charges. Regarding the contingent rate, the Lockerbie Town Council took over the gas-works for which the Company charged a high price. They found they could not manufacture gas and make it pay. It was 6s. 8d. per 1000 cubic feet when the Council took over the concern. They had to apply for a contingent rate. There had been a lawsuit on the subject, and it went through three courts. The rate was first put on at 1d., and then raised to 5d. This, of course, had not been the case for a number of years.

SULPHUR COMPOUNDS OF COAL.

In a recent number of the "Journal of Industrial and Engineering Chemistry" [No. 6; 1914], Mr. S. H. Regester dealt with the subject of the oxidation of the sulphur compounds of coal and of nitrogen in the bomb calorimeter, and the correction to be applied in determining the heating value of coal. According to an abstract of the article in the current number of the "Journal of the Society of Chemical Industry," the results of the experiments indicate that the relative amounts of sulphur trioxide and dioxide in the bomb gases after combustion depend chiefly upon the amount of nitrogen oxides in the bomb, which promote the formation of the trioxide just as in the manufacture of sulphuric acid by the chamber process. The ash of the fuel does not appear to exert any appreciable catalytic action. The formation of nitrogen oxides takes place much more readily from the nitrogen of coal than from the nitrogen present in the bomb gases, and increases with increasing pressure and with the heat of combustion of the fuel. The usual correction applied to the heating value of a fuel, according to the sulphur content, based on the assumption that the sulphur is converted completely into sulphur trioxide in the calorimeter, is satisfactory in the case of coal with less than 2 per cent. of sulphur, burnt in a bomb calorimeter from which the initial charge of air is not removed by rinsing-out with oxygen. In the case of coals high in sulphur, a material amount may be left as sulphide in the ash and as sulphur dioxide in the gas. If the air in the bomb be blown out with oxygen of high purity, so that the concentration of nitrogen in the bomb is only a fraction of 1 per cent., then with a fuel free from nitrogen only a part of the sulphur will be converted into sulphur trioxide. With a non-nitrogenous fuel containing less than 0·08 gramme of sulphur in the sample burnt, approximately quantitative formation of sulphur trioxide is obtained at 20 atmospheres pressure if the nitrogen concentration of the bomb gases be 6 per cent. The heat of combustion (to SO_3) of the sulphur of pyrites was found to be about 4975 calories per gramme.

Deposits in Water-Mains.—The water supply of Cagliari is conducted through iron pipes having a total length of about ten miles, and they become choked periodically with a deposit. That freshly formed was found to be free from organisms, while the older deposits contained *Claudotrix acracea*. The same growth occurred both in iron and steel pipes. According to some investigations of Signori O. Casagrandi and R. Binaghi, as recorded in "Wasser und Gas," and briefly noticed in the "Journal of the Society of Chemical Industry," the formation of the deposit is affected by three factors—viz., the presence of carbon and silicon in the iron, the structure of the iron, and the character of the water; the chief one, however, being the presence of dissolved oxygen in the water.

Institution of Water Engineers.—The winter meeting of the Institution of Water Engineers will be held in the apartments of the Geological Society, Burlington House, W., next Friday and (if necessary) Saturday, when two papers will be read and discussed—one by Mr. J. C. Barrowclough, entitled "Notes on Scraping a 15-inch Trunk Main at Batley," and the other by Mr. C. W. S. Oldham, on the "Whitton Pumping-Station of the Ipswich Corporation Water-Works." The accounts for the year 1913 will be submitted, the ballot will be taken for the election of the Council for the year 1915-16, Auditors and Hon. Auditors will be appointed, and the members will be asked to confirm the decision of the Council to subscribe from the accumulated funds of the Institution a sum of fifty guineas to the Prince of Wales's Fund and twenty guineas to the funds of the Red Cross Society.

Coal Storage under Water.—In connection with the zinc-smelting plant of the American Zinc and Smelting Company, there is an under-water storage, and for this purpose a natural ravine was dammed, so that an area of 4½ acres is covered, affording a storage depth of about 30 feet. The coal-waggons are run out on a steel girder bridge, and dumped into the portion of the reservoir adjacent to the pumping-station of the plant. The coal thus received is sucked up by means of a centrifugal pump, and distributed through pipe-lines, supported on floating trusses, to the part of the reservoir desired. In removing the coal from the reservoir for use, it is pumped out, lifted into waggons, and transported to the smelter. At present about 20,000 tons of coal are stored in the manner described. Besides the convenience, it is stated that the under-water storage has proved satisfactory in a reduction of the losses due to oxidation in weathering.

CORRESPONDENCE.

[*We are not responsible or opinions expressed by Correspondents.*]

The War and Capital-Raising by Statutory Gas Companies.

SIR,—Mr. Herring's suggestion, contained in his letter published in your issue of the 1st inst., is interesting, in that it is an indication that the difficulties ahead of statutory gas companies, in regard to the raising of capital during the next few years, are being realized.

Mr. Herring will, however, forgive our reminding him that the proportion of loan capital permitted by the "Model Clauses" is one-third, not one-fourth. Whether this difference destroys the value of the suggestion is a matter of opinion; but in any circumstances, in our humble judgment, a mere increase of the borrowing power does not meet either the equities or the necessities of the case.

Further, surely existing preference shareholders would have something to say to any material increase in the amount of the securities ranking in front of their holdings.

No, Sir, in our opinion the true policy to be pursued in the abnormal times before us is the removal of all obstacles to the speedy and easy placing of capital, and to make gas investments more attractive to the investor.

A company which is compelled to reduce its dividend, because unprecedented circumstances have necessitated the increase of its selling price of gas, is not the kind of company that an investor would prefer to put his money into, at a time when there will certainly be a wide range of high-yielding investments from which to select.

Nor, on the other hand, having regard to the altered value of money, and the certainty that the investor will require a higher yield on his investment than he has hitherto been content with, is the increase of dividend under the present sliding-scale clauses sufficiently large to offer any real attraction to the investor.

So far as we are aware, there is only one Bill of the ensuing session that proposes to do anything to enable the directors—at least, to some extent—to overcome the difficulties referred to. In this particular case the only provision the circumstances of the case permit is one giving relief from the auction clauses; but we think that the directors of a "sliding-scale" company would be abundantly justified, in the interests of the consumers themselves, in asking Parliament for a revision of the sliding-scale standard, so as to make the shares of their company more attractive to the investor.

Local authorities, it is true, might possibly have some criticism to offer on such a proposal; but we have sufficient reliance on the sense of fairness of the average business man, of whom our local bodies are mainly composed, to feel confident that they would admit its reasonableness.

5, *Victoria Street, S.W., Dec.* 3, 1914. R. W. COOPER AND SONS.

[A reference to this letter appears in an earlier part of this issue, p. 522.—ED. J.G.L.]

Weighing Attachments on Retort-Charging Machines.

SIR,—The credit for priority of this country over America does not alone rest with Messrs. Jenkins's application of the year 1906. Broadhead and Denison's patent, No. 6534 of 1902, was applied to the weighing of charges for inclined retorts. The same patent was adopted for our projector stoking machine for horizontal retorts in the year 1904.

With reference to your request for information, we would say that the mechanism, though quite dependable, is out of place, for the following reason: The modern stoking machine with a handy man, charges retorts in periods of seconds—hence is a speed machine. To limit the potentialities of such a machine by a slow process of weighing each charge—introducing again dependence on the human element—is, to say the least, inconsistent. Therefore the combination of charge-weigher on stoking machines, whatever its advantage to the book-keeper, has not the general support of carbonizers.

For ROBERT DEMPSTER AND SONS, LIMITED,
Elland, Dec. 5, 1914. J. W. BROADHEAD, Managing Director.

Supply of Water for Troops.

SIR,—Since the declaration of war, troops have been billeted in a number of provincial towns, and the question has arisen as to whether the supply of water comes under the head of an ordinary "domestic supply" where troops are billeted in occupied houses.

It has been argued that in such cases the householder receives billeting money from the Government—which covers all expenses, the householder paying water companies for all water consumed in the usual way—and that the military authorities are, therefore, not liable for any charge.

This, of course, meets the case where the supply is metered; but where the charge is based on the rateable value, it is impracticable to levy any extra charge on the householder.

The district supplied by the company in which I am interested has some thousands of troops billeted on it—the population being practically doubled. A large majority of these are in private houses, almost all of which are charged on the rateable value. In these circumstances if the argument mentioned above holds good, the water company will be a heavy loser.

I shall be glad to know, through the medium of the "JOURNAL," the experience and opinion of other officials of water companies on the subject.

Dec. 1, 1914. A SUBSCRIBER.

The Colne Town Council have decided to make application to the Local Government Board for a Provisional Order extending the time for the construction of the Wycollar Water-Works, and the suspension of payments to the sinking fund for two years.

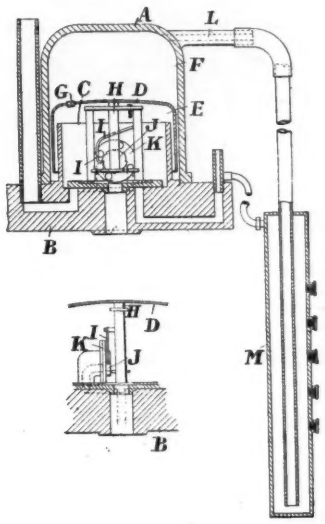
REGISTER OF PATENTS.

Regulating from a Distance the Lighting and Extinguishing of Gas-Lamps.

KENT-JOHNSTON, A. G., of Balham, S.W.

No. 22,690; Oct. 8, 1913.

This gas lighting and extinguishing apparatus is operable from a distance by a sudden increase in the gas pressure being transmitted along the mains. The apparatus is of the type in which a liquid sealed bell, diaphragm, or the like—dividing the space within a casing into two compartments, connected by a small orifice—is subjected on one side to the pressure of the gas in the mains, and is adapted to operate valve means controlling the supply of gas to one or more main and bye-pass burners; "its object being to provide an improved form which shall operate at a lower predetermined pressure than hitherto."



Kent-Johnston's Lamp Lighting and Extinguishing Apparatus.

In the form of the apparatus shown, an outer casing A co-acts with a body member B and an inner wall C to form an annular space containing mercury, which seals the mouth of a bell D. In this way the space enclosed is divided into two compartments E and F, to the former of which gas, admitted through the opening below, passes gradually into the compartment F, through an orifice G, in the bell D, of such a size as to ensure that movement of the bell shall only be effected by some suddenly produced increase of pressure in the mains. The bell is attached to a rod H guided vertically in cross-bars top and bottom. By means of a pawl I carried by the rod, a ratchet wheel J, on the same spindle as the disc K of a valve, is partially rotated during each upward movement of the bell, in order that openings in the disc shall alternately uncover passages leading respectively to a main and to a bye-pass burner, so that when (say) the valve is in the position shown, gas passes to the bye-pass burner.

Leading from the compartment F on the side of the bell remote from the gas-main is a conduit L flexibly connected with a tube which extends below the level of a non-evaporating and the non-freezing liquid in a vessel M, in which the liquid-level can be adjusted by withdrawal of one or more of the screw-threaded plugs at the side. The vessel M is closed, and connected by a flexible tube with the passage leading to the bye-pass burner. In this way the formation of an explosive mixture within the lamp is prevented, while the escaping gas is utilized to prevent failure of the apparatus through one burner being extinguished before the other is ignited.

In use, the apparatus is connected to the mains and gas is permitted to pass by way of the compartments E and F into the vessel M, whereupon liquid is poured into the latter until the gas ceases to bubble through it. It thus acts as a seal and therefore stands at a level corresponding to the pressure of the gas in the mains. More liquid is now added in such a quantity that the pressure may be increased to that at which the apparatus is to operate without breaking the seal, until this maximum pressure is attained. The amount of liquid is ascertained by trial or by filling the vessel up to the level of the side plug which indicates the amount of liquid necessary. Thus (for example) if the gas be supplied at a pressure corresponding to $3\frac{1}{2}$ inches of water and an additional pressure of an inch is required to operate the apparatus, the quantity of liquid placed in the vessel M is such that no gas can escape from the chamber F through the liquid seal till its pressure attains that corresponding to $4\frac{1}{2}$ inches of water column.

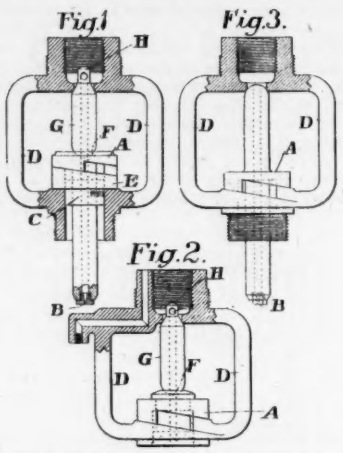
When the apparatus is in operation, a wave of increased gas pressure transmitted through the mains will, if suddenly produced, cause an upward movement of the bell D and a depression of the liquid in M, until, when the pressure is reached at which the apparatus is designed to operate, the gas will bubble through the liquid and pass to the bye-pass burner. As a result of the pressure in the compartment F being relieved, the bell D continues its upward movement until the supply of gas is changed over from one burner to the other; the bell remaining raised until the gas ceases to escape from the compartment F, and the pressure on both sides of the bell becomes equal.

Gas-Lamps.

TILLEY, F. C., of Kingsland Road, N.E.

No. 25,151; Nov. 4, 1913.

The object of this invention is to make gas-tight joints between the gas-nipple holders of burners and other portions of the supply thereto by the movement of one inclined plane over another or of the movement of two inclined plane surfaces in opposite directions.



Tilley's Connecting Joint for Gas-Lamps.

Three examples of carrying the invention into effect are shown. According to fig. 1, the nipple holder has a collar A, with one, two, or more inclined surfaces on its under side; and between the collar and the end carrying the nipple B is another collar C, which fits a hole in the stirrup D and assists in keeping the nipple holder centrally within the stirrup. Between the two collars is a ring E with inclines, on one face corresponding to the inclines on the collar A, and having a bearing on the stirrup. The upper end of the nipple holder is rounded or coned at F on the inside edge of the hole which passes through it in order to receive the connecting tube G. This tube has an extension H provided with right-angled openings connecting the hole of the tube G, which is positioned inside the stirrup at the top part.

Instead of providing a separate ring E with inclines (as fig. 1), the stirrup may be formed with inclines as in fig. 2; and in some cases the loose connecting tube G may be dispensed with, and the nipple tube extended to include it as at fig. 3, in which case the inclines are on the stirrup, and the nipple holder is provided with a ring A having the inclines for action on the other inclines—the collar C being dispensed with to allow of the nipple tube being placed at an angle to be removed from the stirrup.

When the parts are assembled, a turn of the ring E or of the nipple holder will cause one set of inclines to ride-up the other, and so move the nipple holder that a gas-tight joint is made at the meeting parts. In this way it is possible to get at the nipple and its holder and remove them from the lamp without it being necessary to take the lamp from its position.

"Radiants" for Gas-Fires.

DAVEY, J. F., of Wylde Green, MELLOR, P. H., and LINES, A. A., of Woodville, Derby, and YATES, H. JAMES, of Aston, Birmingham.

No. 28,326; Dec. 9, 1913.

This invention has for its object "to provide improved radiants or fuel-pieces for gas-fires." Heretofore, as the patentees remark, such radiants have been produced entirely from refractory materials—such as compounds of fire-clay; and, owing to the brittle nature of the materials when baked, the radiants are liable to breakage. But, according to the present invention a metal skeleton of substantially the same shape as the article to be produced is constructed from wire, strips, perforated sheets, or other suitable material. The skeleton is then immersed in a "slip" or thick fluid of the required refractory materials and of the required thickness. The slip may consist of clay, sawdust, burnt clay, sand, emery, carborundum, steatite, or similar materials, with or without the usual addition of silicate of soda and pearl-ash. The whole is mixed with water, so that it will adhere to the metal skeleton, and form thereon a coating or deposit, to bring it to the required consistency. After the skeleton has been coated, it is baked in the ordinary manner.

The inventors point out that "the liability to breakage which is experienced with ordinary radiants is largely avoided, by the use of a metal reinforcement."

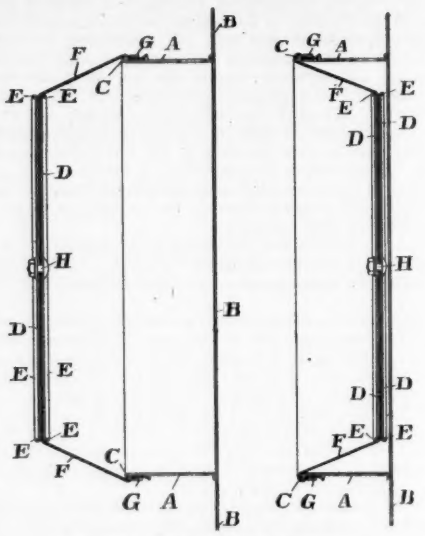
Dry Gas-Meters.

GLOVER, THOMAS, of Angel Road, Edmonton.

No. 9479; April 16, 1914.

This invention relates to the bellows of dry gas-meters, of the type wherein a ring is attached to the middle partition of the meter, and the edge or periphery of a flat disc of leather is secured to the ring, and also the type in which the central part of the disc of leather is attached to a pair of discs or diaphragms secured together one on each side of the leather. The improvement consists in forming a bead on the outside edge of the ring attached to the middle partition and securing the flat leather disc to the ring by a removable strap or band in such a manner that the parts are readily removable for alterations or repairs. In this way, a bellows is said to be obtained "having the proper capacity without any adjustment."

The ring A is soldered to the middle partition B; and on the exposed edge of the ring is formed a flange or bead C extending outwards. There are two diaphragms D, preferably having curled edges E to strengthen them and keep them flat. The usual leather F is employed, and a tightening ring G, which is provided at its ends with a right-and-left hand-screw for tightening purposes.



Glover's Dry Gas-Meter Bellows.

In assembling the parts, the two diaphragms D are first connected, one on each side of the leather F, and secured together by a screw bolt and nut H with the leather between. The diaphragms are then laid within the ring A and on the casing B, with the leather surrounding the edge of the ring. The leather F is next folded down outside the ring, and the band G tightened, which will secure the leather on to the ring in a gas-tight manner; the bead C preventing the ring being pulled off.

Now if the diaphragms D are made of a certain size, and the ring A of a determined size and depth, the cubical capacity of the bellows will be always the same—all that is necessary being to hold the diaphragm on to the partition B while the leather is being stretched over and secured to the ring A.

APPLICATIONS FOR LETTERS PATENT.

22,909.—BEAMISH, W. R., and HIGGINSON, G. S., "Gas-furnaces." Nov. 23.

22,953.—ALDRIDGE, J. G. W., "Stoking gas-retorts." Nov. 23.

23,025.—ROLLASON, A., "Producing oil from coal." Nov. 25.

23,052.—SMITH, H. E., "Manufacture of water gas." Nov. 25.

23,165.—PRIOLEAU, J. R. H. & W. L., "Gas manufacture." Nov. 27.

23,174.—EHRICH AND GRAETZ, "Gas-lamp." Nov. 27.

LEGAL INTELLIGENCE.

INJURIES CAUSED THROUGH A GAS EXPLOSION.

New Tenant's Use of an Unfinished Installation.

At the Leeds Assizes on the 28th ult., Amos Stott sued the Redcar, Coatham, Marske, and Saltburn Gas Company for damages for personal injuries sustained in an explosion of gas caused, it was alleged, by the Company's negligence. Plaintiff was the tenant of a house at New Marske which the Company had fitted up for gas on the prepayment system. He and his wife went to the house, and, finding brackets, burners, &c., fixed and the meter connected, plaintiff put a penny into the meter, and went upstairs to light the gas in the kitchen. The burner would not light, however, and he went down again and found he had omitted to turn on the tap which supplied the burner. On re-entering the kitchen he struck a match, and a violent explosion took place which threw him across the room and severely burnt his face and right arm. The cause of the explosion was an escape of gas from a pipe which projected through the ceiling, and which neither the plaintiff nor his wife had noticed. The purpose of this pipe was to enable a connection to be made, if required, to a cooker or grill. The negligence alleged was leaving the pipe unstopped. Plaintiff was unable to work from Oct. 28, 1913, to Jan. 6, 1914, and for some months afterwards he could not earn such good wages as before. His total loss was about £32. For the defence, it was contended by Mr. E. Meynell that there had been no negligence on the part of the Company, as no notice had been given by the plaintiff of his intention to use the installation, and he had not entered into any contract. Further, the plaintiff had made no inquiries as to whether the work was finished, or whether it was safe to use the gas or not. In reply, Mr. E. Tindal Atkinson, K.C., argued that with a prepayment meter no contract was necessary; and seeing the fittings all ready and the meter connected, his client naturally assumed that everything was in order. Evidence was given by the plaintiff and his wife, three doctors, the Secretary of the Company, and the man who fixed the installation. In the result, the Jury found for the plaintiff, with £50 damages.

MISCELLANEOUS NEWS.

THE MODERN GAS-FIRE IN THE COAL-GRATE.

[Reprinted, by permission, from "The Builder," Nov. 13.]

There is no doubt that every architect and builder has had experience in the past in connection with fixing gas-fires in coal-grates, as there was always a demand for such fires by people who preferred this type instead of those efficient but undoubtedly ugly portable gas-fires (of patterns which are now out-of-date) that used to be fixed in front of the coal-grate. Within the past few years, however, the situation as regards gas-fires has materially changed; and the stigma of ugliness can no longer be justly applied to modern portable gas-fires, which enterprising gas-stove makers and gas companies are supplying and fixing in very large numbers. But what of the gas-fire in the grate, for which in some quarters there is still a constant demand?

The Faults of the Old Gas Grate-Fires.

We all know the old gas grate-fire, which was usually made up by placing a burner in the grate, with holes in the top of the burner, from which gas-flames issued. A firebrick was then often fixed right at the back of the grate, regardless of whether it gave less or more efficiency in this position; and the whole was crowned by a heap of fireclay balls or lumps, which were piled indiscriminately on the burner. These old grate-burner fires were very extravagant in gas consumption; but it must be admitted that if sufficient gas were consumed, and there was a good draught to the chimney to take away the products of combustion, they gave a very good result when first installed. But, unfortunately, in course of time, dust and pieces of the fireclay balls, as these became broken, would fall into the holes from which the gas-flames issued; and the fire then became an abomination to the eye, and all too frequently to the nose also. An old pattern burner fire more especially became an abomination to the nose when it had been in use after and during the time that the burner had fired-back, which in the oldest pattern of this type of fire was of very frequent occurrence. The burner then rapidly became foul with carbon; and in consequence it would fire-back more and more frequently—thus forming more carbon inside it, and causing a large amount of this to be deposited on the fuel, until eventually the fire became almost entirely choked, when it became impossible to use it until the whole structure had been removed from the grate and the burner taken to pieces, cleaned, and refixed, this being rather a lengthy, and therefore an expensive, operation.

The efficiency of the fire was naturally decreased very materially during the period that the carbon was collecting in the burner; and on the fireclay balls and brick. It is a moot point as to whether the customer who used the fire was comforted when he discovered that what he had lost in efficiency he made up in smell, owing to the fact that the gas-flames impinging on the carbon provided him with a great amount of this.

However, as the back-firing trouble was such a serious one, a great deal of attention was paid to the subject by that well-known gas scientist, the late Mr. Thomas Fletcher, of Messrs. Fletcher, Russell, and Co., Limited, of Warrington and London. He may also be remembered as the author of a useful work on gas heating, entitled "Coal Gas as a Fuel." After many experiments, Mr. Fletcher at last succeeded in designing a grate burner that would not fire-back in ordinary use. This burner was first patented in 1894, but was improved and repatented in 1908, and many thousands of such burners have been fixed.

In spite of this great and all-important improvement, however, there were still a number of serious defects in the gas-burner grate-fires. These may be enumerated as follows: (1) It must be admitted that while the patent burner could truly be spoken of as a non-back-firer, it unfortunately did not remain in this condition for ever, owing to the fact that the non-firing-back cone inside the burner lay right underneath the flame openings; and in consequence the cone after a time became clogged with dust and pieces of broken fireclay, when it became of little value in preventing the burner from firing-back. (2) The firebrick was still often fixed right at the back, whether the grate was a shallow or a deep one. (3) The fireclay balls, which were egg-shaped, with closed ends, were always placed in an irregular heap on the top of the burner orifices, owing to these not being specially spaced to suit any particular arrangement of the balls. This irregular arrangement and the shape of the fireclay balls caused the bunsen gas flames to be broken at their base.

It is now well known as a scientific fact that, in order to obtain the greatest heating efficiency from the bunsen gas flame, it should be permitted to burn freely, with a good supply of secondary air, and that if perfect combustion is desired, the inner (or smaller) cone of the bunsen flame should remain unbroken.

Modern portable gas fires well illustrate this principle, as in all patterns of these it is noticeable that each individual bunsen flame is allowed to burn itself out unbroken. Each flame plays up inside—and accordingly heats—its own hollow pillar of fireclay, instead of, as in the older types of gas-fire, trying to struggle through an irregular mass of fireclay lumps.

Another fault of the old gas grate-fire was that the burner was so constructed that 2 inches or more of dead-black iron was always bound to be showing at the bottom of the grate. This was because the flames came out at the top of the burner, and the top of the burner was naturally well above the bottom of the grate on which it stood. Again, there was no method by which the gas-fitter could easily arrange for the proper proportion of gas and air to mix together in the burner to suit the local pressure or composition of the gas. In consequence, fires were frequently fixed with the bunsen flames roaring so badly as to be almost unbearable, because there was too much air in the mixture, or they were left burning white and depositing carbon on the fireclay balls, because there was too much gas in the mixture.

The fitter was very much to be excused when either of these faults occurred, because when the mixture was not correct the only way to remedy the trouble was to remove the gas-injector from the burner, and to either open or close its orifices according to the nature of the complaint. It may be readily understood that after an average gas-fitter had finished fixing a grate-fire and had lighted-up, he did not feel inclined to disconnect it again to remove the burner, for the purpose of either opening or closing the gas injector—especially owing to the fact that he might do all this, and put the whole fire back again, and then discover that he had gone too far in the opposite direction, and that he must either go through the whole process again or leave well (or bad) alone. His employer's and the customer's comments on the excessive time taken in fixing the fire had also to be considered.

It must also be remembered that the gas-injectors were two-sided, and constructed in the form of a T, which was fixed inside the centre of what was known as the mixing-tube of the burner; the gas being delivered into this mixing-tube from the injector in both directions, left and right of the centre. This was considered necessary in order suitably to mix the gas and air and to keep the flames equal in length, and the burners were sent out by the manufacturers regulated so that the length of the flames was equal along the whole width of the burner. It will be quite understood, therefore, that when a fitter took a burner to pieces and endeavoured to alter the size of the orifices of the injector, he stood a great risk of doing this unequally on the two sides, and the result was a burner with flames of unequal length, very high on the left and very low on the right, or *vice versâ*, or roaring one side and burning white on the other. No matter how well they were fixed, however, they were usually more or less noisy.

Another fault was that the burners were only obtainable in two standard shapes—curved or straight—and the fire was not always required to be fixed in an exactly straight or an exactly curved grate. In such cases the fitter had, perforce, to fix a burner that was nearest to the actual shape of the grate. This naturally did not always give an altogether satisfactory result, because frequently, owing to the incorrect shape of the burner, it did not follow the line of the grate-bars, and there was either very little fire to be seen at the ends, because the gas-flames in that portion of the burner were too far back from the bars, or the same complaint occurred as regards the centre of the fire, for a somewhat similar reason.

Finally, the fires did not very much resemble coal or coke fires when they were burning, and customers who favour gas fire-grate fires undoubtedly have a strong leaning towards such an appearance, if it can possibly be obtained. Therefore, when the revolution in the design, structure, efficiency, and economy of portable gas-fires took place, it seemed likely that the old gas grate-fire and the demand for it would gradually disappear. But we are informed by a representative of a large London gas company that this did not prove to be the case. As a matter of fact, there was still a considerable demand for such fires, in spite of the fact that their faults were still commented on by those who had to handle and fix them. This caused the gas-stove manufacturers to give serious consideration to the situation, and encouraged them to make further attempts to correct the faults which have been enumerated. This particularly applied to the firm we have previously mentioned, who, being also coal-grate manufacturers, realized that there are some modern coal grates of simple and attractive design in which it would be impossible, with any degree of satisfaction (either to fitter or customer) to fix one of the ordinary old pattern type of gas-burner fires. They had also to bear in mind the fact that architects, builders, or their clients, would sometimes not permit the fixing of one of the portable type of gas-fires in front of such grates, however much it might be desired to obtain the benefit of the convenience and saving of labour which always accompanies the use of a gas-fire. A long series of experiments were therefore carried out; and as a result these manufacturers succeeded in improving the design and construction of gas grate-fires so materially as to overcome all the faults and objections which we have mentioned. After this had been accomplished, they also succeeded in designing gas grate-fires which can be easily and economically fixed in any of the modern roll-bar "well," "heaped," or other types of barless grates without in any way altering or damaging their design or appearance. These fires can be rapidly and easily removed if at any time this is desired.

Improvements Contained in the Modern Gas Grate-Fires.

It is interesting to note in what manner the old faults and troubles were overcome. We will, therefore, enumerate these points in the same order as they were previously raised.

First.—The new type of gas-burner fire, which is constructed to fit inside grates with bars, is known as the "Jet" grate fire [Patent No. 20,538 of 1911]. It is also covered by the non-firing-back patent, dated 1908. These fires are by no means extravagant. Their consumption for an equal heating power does not exceed two-thirds of the amount that was consumed by those of the old pattern. Moreover, their purchase price is low, and they are very simple to fix.

Second.—The firebrick is always fixed in such a position as to allow just two thicknesses of fireclay fuel between it and the front bars of the grate when these are straight. When the bars are curved, there are two thicknesses of fuel at either end, and extra packing in the centre to allow for the curve. This position has been found to give the best results from the points of view of both appearance and efficiency. The brick, being somewhat forward, gives a better radiant efficiency than if it were set further back. But as it is two rows back the fire looks better than it would if only one thickness of fuel were placed between the brick and the bars. This arrangement gives an appearance of depth to the mass of glowing heat because the brick is not visible.

Third.—The burner is truly non-firing-back, and it remains in this happy condition. One reason for this is that it contains the Fletcher non-firing-back cone attachment previously mentioned. But what is of equal importance is that this attachment remains unchoked by pieces of broken fuel, &c., because there are no flame orifices above the cone through which these could fall. The cone is set right back inside the burner, and a number of elbows are screwed into the front of the burner. When the burner is placed flat on the bottom of the grate the fronts of these elbows come close to the bars, and the flames issue

from their outlets instead of from holes in the top of the burner, as in the past. Any dust or small pieces of broken fuel that drop in the elbow jets are easily removable. In any case these can have no effect on the non-firing-back qualities of the fire, owing to the fact that the patent cone is so thoroughly protected and out of the dust area, as previously explained. [See fig. 1.]

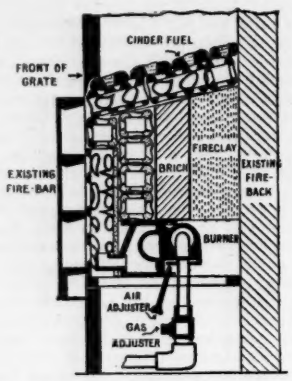


Fig. 1.—Section of a "Jet" Burner Fire Fixed in a Grate.

Fourth.—The burner has been so arranged as to permit the fuel (or fireclay pillars and cross-pieces) to be packed in a correct manner, and not in an indiscriminate heap. The elbow jets are accurately spaced, and just permit one piece of the specially-designed upright pillar fireclay to be placed over each of them. When this has been done, the result is an unbroken line of upright pillar fuel. Cross-pieces of fuel are placed between these upright pillars and the firebrick, in order to make up the two thicknesses to which we previously referred, with extra packing at the back, in the centre, if the bars are curved. A layer (or layers) of cross-pieces of fuel is then placed over these and the top of the brick; and if it is desired a finish may be made with a layer of what is known as cinder fuel, which somewhat resembles coke in appearance.

Fig. 2.—The "Jet" Burner for a Straight-Bar Grate.

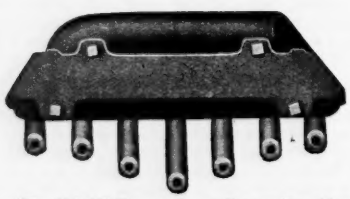


Fig. 3.—The "Jet" Burner for a Serpentine-Bar Grate.

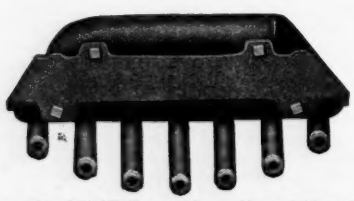


Fig. 4.—The "Jet" Burner for a Curved-Bar Grate.

Fifth.—This arrangement of the fuel permits each bunsen flame to burn itself out, so to speak, with its inner cone unbroken. Each flame has its own hollow column of pillar fuel, up which it travels before it curves-back in order to heat the top fuel. The cross row of fuel between the pillar fuel and the brick is heated by contact with the pillar fuel; the firebrick in its turn takes up and radiates heat; and the resulting effect is a good glowing fire. Perfect combustion of the gas consumed is also ensured, owing to the fact that the inner bunsen cones are unbroken, and the best radiant heating efficiency naturally follows.

Sixth.—The old ugly two or more inches of iron burner no longer shows at the bottom of the grate. The burner is entirely hidden, because the upright pillar fuel comes right down over the elbow jets and touches the bottom of the grate. The fire, therefore, starts right from the bottom, instead of a few inches up the bars.

Seventh.—The burner is made with simple gas and air adjusters, which are easily get-at-able after the fire is fixed. The correct mixture of gas and air and length of flame may, therefore, be obtained by the fitter when he has connected-up the burner and before he packs the fuel. A slight readjustment may be made at any time without removing the burner. The injector has only one set of holes, and the gas is delivered from these into the mixing-tube in one direction only. It is not two-sided, in the form of a T, with deliveries left and right, as in the past; therefore one does not get the uneven effect previously

Fig. 5.—Ordinary Coal Grate with Bars.

Fig. 6.—Showing the Same Grate Fitted with the "Jet" Burner Fire.

mentioned—viz., the flames on one side of the burner high and the other low, &c. One very important result obtainable by the correct use of the gas and air adjusters is that the fire may be so adjusted as to burn without the distressing noise that used to be such a drawback to gas grate-fires.

Eighth.—The burners are obtainable in five widths—viz., 9 inches, 10½ inches, 12 inches, 13½ inches, and 15 inches overall, containing six, seven, eight, nine, and ten elbow jets respectively. There are three standard shapes of each size constructed to suit grates with either straight, curved, or serpentine front bars. There is no limit, however, to the adaptability of the burners, as they can be made-up to suit

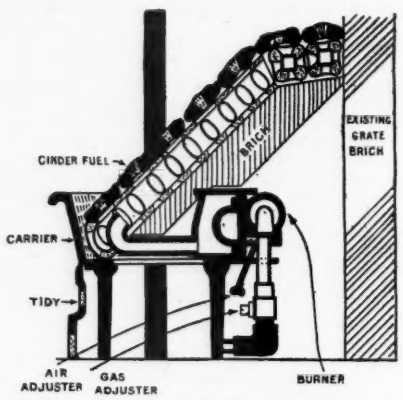


Fig. 7.—Section of a "Grosvenor" Fire Fitted in a Barless Grate.

grates with bars of any shape. As before mentioned, the elbow jets are screwed into the front of the burner. These jets are manufactured in various lengths from 1¼ inches, rising by ¼ inch at the time to 2¾ inches long. It can be readily seen, therefore, that if a paper template of the grate bottom and bars is taken, a burner with elbow jets of suitable lengths may then be made-up by the manufacturers, who supply burner fires to suit any shaped template submitted to them. It is usually only necessary, however, to order a straight, curved, or serpentine burner, as the average grate comes within this category. Another important feature which accompanies the use of these elbow jets is the

Fig. 8.—A Barless Grate converted into a "Grosvenor" Gas-Fire.

fact that a fire that has been used in a straight-bar grate may, at a very small expenditure of time and material, be altered to suit one with serpentine or curved bars, or *vice versâ*. This can be done by simply altering some of the elbow jets, substituting others of different lengths where necessary. Simplicity and adaptability in all things is what has been aimed at in the construction of these fires.

Ninth.—When the fires are finished off with a top layer of cinder fuel, which is supplied with them if required, they very much resemble when in use a coal, or, perhaps, more strickly speaking, a good coke fire. Figs. 5 and 6 show an ordinary coal grate with bars before and

after being fitted with a "Jet" fire. All the above-mentioned particulars refer to burner fires which are required to be fixed in coal grates with bars.

Modern Gas Grate-Fire for Barless Grates.

We now come to the more modern style of coal grates—viz., those of the "well," "Devon," "heaped," or other barless types, which are now being fixed in their thousands in suburban and other residences. The ordinary gas-burner fire was, and is, useless for such grates; but the manufacturers have succeeded in overcoming all the difficulties that presented themselves. Moreover, in doing this they make use of exactly the same non-firing-back burner as that used for grates with bars. They have simply varied the shape and length of the elbow jets and the shape and style of the firebrick and fuel, in order to produce fires suitable for barless grates. These are known as the "Grosvenor" and the "Mayfair" grate-fires.

The "Grosvenor" Grate-Fire.

In order to overcome the lack of grate bars and bottoms, and to make it unnecessary to use the coal grate fire-box (where there is one, and unless the client prefers this to remain), the "Grosvenor" fire is supplied complete with an iron carrier, on which the burner, firebrick, &c., is rested. This carrier is simply placed into the coal-grate opening, when this does not include a fire-box, or it takes the place of the fire-box when one has been removed. (See section, fig. 7).

It will be noticed in the section that the elbow jets in this burner are turned backward, in order to throw the flames backward and upward at an angle of about 45°. The firebrick is rested on the burner, with its bottom edge on the elbow jets. When the brick is sealed to the coal-grate sides and back with fireclay, it forms a sort of platform on which the backs of the long fireclay pillars are laid after they are placed over the ends of the elbow jets. A layer of cinder fuel is placed on top of the fireclay pillars, completely covering them; and when the burner is lighted an effect is produced similar to that given by a good piled-up coke fire.

The whole apparatus is very easily fixed and removed, without in any way altering the appearance, or damaging the structure, of the coal grate. This type of fire can also be used to turn a coal grate with bars into a barless gas-fire. All that is necessary is to remove the bars, and, if possible, the grate bottom, and to fix the gas-fire with a burner carrier, as in the case of a barless grate. If the grate bottom is a fixture, this presents no difficulty, as the legs of the carrier may be unscrewed and the carrier frame be bolted to the grate bottom.

The "Mayfair" Grate-Fire.

This is most frequently fixed in grates of the barless or "heaped" type; and it is intended for use in cases where the piled-up appearance of a coal-fire is not essential, but where the fullest radiant efficiency is desired. This great radiant efficiency is obtained because there is a very large area of firebrick, which is subjected to the heating effects of the gas-flames; and the firebrick, being well forward, radiates a large amount of heat into the room. In appearance the "Mayfair" grate-fire resembles a modern portable gas-fire that has, so to speak, grown in, and is part and parcel of, the coal grate.

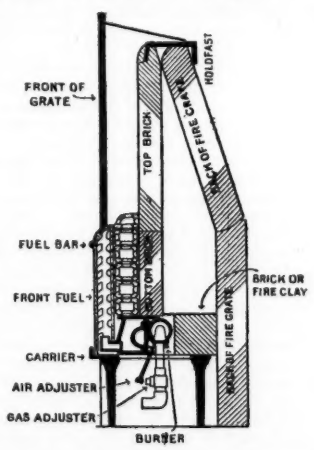


Fig. 9.—Section of a "Mayfair" Fire Fitted in a Barless Grate.

It is made up with the same burner as the other fires mentioned, and has a burner carrier, which is placed in the grate opening in a similar manner to that for the "Grosvenor" fire. The firebricks, of which there are two—*i.e.*, top and bottom—are of various widths. They are supplied in sizes, increasing an inch at a time, 11 inches, 12 inches, and so on to 17 inches, according to the width of the grate opening for which they are required. They are of sufficient height to reach to the top of the average coal-grate back brick, to which they are attached with a dog, or holdfast, after they have been sealed all round with fireclay. The fuel also is specially designed. A bar or fuel-holder is screwed to the metal sides of the coal grate after these have been suitably drilled and tapped.

While this type of grate-fire is not quite so simple to fix as the others, its fixing should present no serious difficulty to a good gas-fitter, especially as the manufacturers publish a fully illustrated and descriptive pamphlet, and in addition to this deliver an explanatory fixing instruction card (showing sectional photos) with every fire.

A Sub-Committee of the Burnley Corporation have been appointed to discuss with representatives of the Padiham Urban Council the question of the amalgamation of the urban district with the County Borough of Burnley.

OLDBURY GAS SUPPLY UNDERTAKING.

Position Discussed by the Council.

An important discussion of the position of the Oldbury gas undertaking took place last Friday at a meeting of the District Council presided over by Mr. J. W. D. Pratt. It arose on a recommendation from the Gas Committee that the gas used for lighting, cooking, and domestic purposes should all be charged for at the same rate per 1000 cubic feet and that the prices be as follows: Under 50,000 cubic feet per quarter, 2s. 6d.; 50,000 to 100,000 cubic feet, 2s. 4d.; over 100,000 cubic feet, 2s. 2d.—all less 5 per cent. discount. The price of gas used for motive power and trade purposes to be 1s. 6d. per 1000 cubic feet net. The Committee further recommended that no alteration should be made in the price charged to prepayment consumers.

Mr. Wortley drew attention to the fact that the new scale of charges meant an increase in the price of gas for cooking purposes from 2s. 2d. to 2s. 6d. per 1000 cubic feet; and he said he did not consider such a step was calculated to encourage the use of gas fires and cookers. He asked whether the change was needed because no profits were being made at the gas-works. According to their reports, the profits had been £1000 and £1500 respectively.

Mr. W. T. Davies thought that to raise the price of gas for cooking purposes was a wrong step, and he suggested that it would have a tendency to discourage the use of cooking-stoves. He asked whether it meant that the Gas Committee intended to do away altogether with the second meter, and hoped to effect a saving by only having one meter for lighting, cooking, and heating purposes in the future.

Mr. Machin said he did not feel that they were offering any very great inducement to manufacturers to come into the district by fixing the price of gas for power purposes at 1s. 6d. per 1000 cubic feet.

Mr. G. N. Robbins asked if in offering manufacturers gas at 1s. 6d. they were not doing it at less than cost price.

Mr. Tomlinson (the Chairman of the Gas Committee): No.

Mr. Robbins asked whether the gas was costing them 1s. 5¾d. per 1000 cubic feet to manufacture, and why the Council could not have the actual figure. He did not see why slot-meter consumers should be called upon to pay a higher price than other people; and he thought the report should go back to the Committee.

Mr. Wilson said the basis upon which the Committee had worked in the past was that they should not lose money on the gas sold; and while they were not desirous of making a substantial profit out of the gas supplied for motive and trade purposes, they insisted that there must be a margin on the right side. They had increased the price to manufacturers from 1s. 4d. to 1s. 6d. per 1000 feet; but this was entirely due to the increase in the cost of materials in connection with gas making. The new Manager (Mr. C. H. Carder) had gone very carefully into the slot-meter charges; and the Committee, after conferring with him, considered they were giving this section as good value for their money as the ordinary consumers at 2s. 6d. per 1000 feet.

Mr. H. Robbins supported the recommended revision in the prices of gas, and contended that the present state of the gas-works was due to bad management. They had at the bank a large overdraft of £6000 or £7000, and this he urged was not all due to the high price of coal and the reduction in the price of residuals. Now they were putting the undertaking on a proper footing, which had never been done before. He supported the increased prices.

Mr. Wallace disagreed with the recommendation to increase the price of gas for cooking purposes, and said he would like to know what the extra expenditure through the advance in the price of coal and the reduced price for residuals would amount to, and also what would be the increased revenue from the additional charges imposed.

Mr. Machin referred to the prices charged to ordinary consumers in Birmingham—1s. 6d., 1s. 7d., 1s. 9d.—the highest being 1s. 11d. per 1000 cubic feet. Surely, he said, Oldbury could buy their coal as cheaply as Birmingham.

Mr. Carder said, from an examination of the accounts of the gas undertaking after his appointment, he noticed that they had a large overdraft at the bank, and that their capital was heavy. Part of the capital expenditure had been incurred by the provision in one house of two meters, and by different services and house distribution systems. These were expensive systems to instal; and he submitted to the Committee that the heavy bank overdraft and the capital expenditure gave grounds for the consideration of the price of gas. Economy in capital expenditure was absolutely necessary; and he suggested that the cost of the second meters, which was considerable, would be obviated by making one charge in future for all gas used for domestic purposes. They could not compare Oldbury with Birmingham; but he gave figures to show that at Oldbury they were selling gas for heating, lighting, and cooking at lower prices than at Dudley, Stourbridge, or Tipton. The estimated increase in revenue as the result of the advanced prices recommended would be £550 per annum; but they had to face a decrease of something like £500 in the value of residuals through a depressed market as the result of the war.

Mr. Machin said that in the past they had assisted the rates from the gas profits; and he could not understand why they should now have such a large overdraft.

The Clerk said it was not correct to say that the overdraft on the gas undertaking was due to mismanagement, as the bulk—practically the whole—of it was a loan sanctioned for the erection of a new gas-holder, and the money was borrowed from the bank instead of from other sources.

Mr. Tomlinson expressed pleasure that the members of the Council had taken more interest in discussing the question of the management of the gas-works than he had known for many years.

Ultimately an amendment, to give prepayment consumers 30 cubic feet of gas for a penny instead of 25, was rejected; and the recommendation of the Committee with regard to the price of gas for cooking-stoves was referred back for reconsideration—it being generally accepted that a discount of 1s. per quarter should be allowed to users of gas for culinary purposes.

Mr. Machin offered his congratulations to the new Manager, who, he said, had given the Council more information in five minutes than he (the speaker) had received in two years.

RE-ORGANIZATION OF THE LEEDS GAS UNDERTAKING.

A Scheme for the Meadow Lane Works—Reports by the General Manager and Mr. W. R. Herring.

In connection with the minutes of the Gas Committee, an important scheme for the re-organization of the Meadow Lane Gas-Works was considered by the Leeds City Council at a meeting last Wednesday. The proposals were set forth and fully explained in reports submitted to the Committee by the General Manager (Mr. W. B. Leech) and Mr. W. R. Herring.

Recommendations of the General Manager.

In presenting his report and recommendations for bringing the undertaking up to date, Mr. Leech expressed the opinion that the prime consideration of the department should be to supply gas at the cheapest rate to all classes of consumers. Under present conditions, and with the existing plant, it would be impossible to attain this object. The capital value of the undertaking on March 31 last was £1,948,067, entailing a charge for interest and redemption fund of over 8d. per 1000 cubic feet of gas sold. The only way of minimizing the effect of this burden is by largely increasing the sales of gas; and this can only be done by reducing the cost of production and lowering the price to the consumer. The recommendations may appear rather drastic, and the initial expenditure heavy; but the result would, he is convinced, more than justify the outlay.

New Wortley Works.

The New Wortley works have been kept in a fair state of repair, and considerable credit is due to the Works Manager (Mr. Webb) for bringing them up to their present efficiency with the means at his disposal. These works have a total manufacturing capacity of 8,000,000 cubic feet of gas per day.

No. 1 Retort-House.—This house contains 48 retorts in regenerator settings, and 139 retorts in direct-fired settings, making a total of 187 retorts, capable of producing 2,500,000 cubic feet of gas. The retorts are charged and discharged by means of West's stoking machinery. The plant, with the exception of the regenerative settings, is of an obsolete type—expensive to work both as regards fuel and labour—and should be replaced in the near future by modern plant.

No. 2 Retort-House.—This house contains 216 retorts, divided into three benches, all being of a fairly modern type of regenerative settings, in good condition, and capable of producing 3,100,000 cubic feet of gas. The retorts are charged and discharged by up-to-date stoking machinery (Arrol-Foulis chargers and Williams-M'Phee discharging machines). The coal-handling plant is satisfactory, with the exception of the moving and emptying of the coal-waggons on the gantry.

No. 3 Retort-House (Low Yard).—This house contains two benches each consisting of 88 inclined retorts. The plant is capable of producing 2,400,000 cubic feet of gas. During the past twelve months, a large amount of money has been expended in remodelling the plant; and a considerable portion of the work has yet to be done. Mr. Leech is of opinion that this money might have been spent to better purpose. The coal-handling plant is an efficient one.

There is no coke plant attached to any of the three retort-houses. The works are divided into two parts by Wellington Road, which considerably increases the working costs, on account of the extra supervision and staff required. Both yards are too small for the plant they contain; and there is very little room for coal and coke storage.

Recommendations.

The carbonizing plant in No. 2 house has been brought up-to-date, with the exception of the method of handling the coal and coke. Within the retort-house the coal-waggons are being moved and emptied by hand. He recommends that suitable capstans be erected on each gantry, and that two hydraulic waggon-tippers be fixed to each hopper on the gantries of No. 2 house. The cost of such an installation would be approximately £800, and the estimated saving per annum £150.

He also recommends that a telpher plant be installed in No. 2 house for dealing with the coke. This plant would carry the coke to the yard, where it would be dealt with by the screening and loading plant, or else put into stock by a steam-crane. The estimated cost of such a plant would be £7500, and the saving at least £2500 per annum.

Regarding the workshops, the block of buildings at present accommodating the office staff, the joiners, blacksmiths, fitters, and stables, should be so arranged that the several fitting-shops and smiths' shop be brought under one roof and properly equipped. To enable this to be done, the office staff would have to be moved. A suitable place for the new offices would be the house occupied by the Manager of the works. These suggested alterations would cost approximately £535.

Meadow Lane Works.

These works are capable of producing 5 million cubic feet of gas per day.

The carbonizing plant consists of one bench of five beds each containing eighteen 4-metre Dessau vertical retorts, capable of producing 1,150,000 cubic feet of gas. This bench was set to work in December, 1913. The coal-handling plant is complete, with the exception of capstans for moving the waggons and hydraulic waggon-tippers for emptying them. The coke is delivered into the yard by means of a De Brouwer hot-coke conveyor. The small coke is screened out into a storage hopper; but there is no storage room for the large coke. At the present time, the surplus is being removed by carts. It is hoped, however, at an early date to complete the telpher plant extension arranged to deal with the coke from these retorts, and effect a considerable saving.

There are also four benches of seven beds, each containing seven 20-feet inclined retorts, capable of producing 2,750,000 cubic feet. The coal-handling plant for these benches is in good order, with the exception of the delivery into the breakers. At present, two men are required to regulate the flow of coal from the receiving hopper to the breakers. This work should be done by jigging screens. Also capstans are required for moving the waggons, and hydraulic waggon-tippers to empty them. The coke is dealt with by means of a telpher plant, which was put into operation for the first time on Aug. 6.

There are also three benches of ten beds and one bench of eight beds, each containing five 20-feet horizontal retorts; the four benches being capable of producing 2,000,000 cubic feet of gas. These horizontal benches are quite obsolete, being direct fired, and charged by hand.

The works generally are in a poor state of repair; and there appear on every hand signs of the complete absence of the engineering and scientific methods necessary for the economical production of gas.

The railway sidings in the works are dangerous, as well as very costly to work, and should be altered as soon as possible. By the proposed re-arrangement, all overhead lines are done away with, the ground they cover (amounting to 2000 square yards) being reclaimed.

The retort-benches have suffered from a lack of intelligent supervision; the irregular heating of the retorts resulting in a considerable loss of gas. In fact, the heating of the inclined retorts is little better than if they were direct-fired. Mr. Leech recommends that an experienced man (preferably with laboratory training) be engaged to supervise the whole of the plant.

The methods of dealing with the gas from the retorts to the holders were deplorable. As far as possible these faults have been remedied. The exhausters were re-set to give a pull of 10 inches on the foul gas-mains of the inclined retorts. This was necessitated by the fact that no equilibrium pipes had been fixed to the hydraulic mains to prevent the syphoning of the liquor seal. Instead of the equilibrium pipes, the covers had been removed from the overflow boxes, and the depth of the curtain or diaphragm plates was increased by pieces of match-boarding. This rendered the overflow-boxes useless, and filled the hydraulic main to within a few inches of the top with liquor, thus increasing the seal to the extent of 10 inches. Also a large quantity of air was drawn through the open overflow-boxes. When the horizontal and vertical retorts were working, it was evident that 10 inches vacuum was too much, so the crude gas from these retorts was passed through the tower-scrubbers, which acted merely as a resistance on the main, and reduced the pull. Retort-house governors have been installed in the inclined and vertical retort-houses, and the pull reduced to allow for ordinary working conditions. A largely increased yield of gas of a better quality has resulted from these alterations; but on account of the back-pressure thrown by the purifiers, it has been necessary to defer continuous working until the tar-extractors recently ordered have been installed.

The purifiers are quite out-of-date both as regards size of unit and type. They are expensive to work, and there is a great deal of trouble with back-pressure. The valves on the older purifiers are worn out and leak very badly. The connections are small, long, and tortuous, thus restricting the flow of gas.

The workshops are badly equipped, and the supervision is poor. The staff is far too great for the size of works; but the condition of the plant at the present time will not permit of any reduction.

The station-meters are in poor condition. There are very few gauges for ascertaining the pressure or vacuum of the gas at the different points of the works. The methods of dealing with the coke and breeze are of the most primitive character.

Recommendations.

These works are in such a condition, says Mr. Leech, that he is compelled to recommend an almost complete reconstruction as necessary to put them into proper working order. The scheme he recommends will modernize the whole plant, and increase the total capacity of the works to 8½ million cubic feet of gas per day.

Carbonizing Plant.—Discard the old horizontal benches and convert the retort-houses into a coal-store. In place of the overhead railway, erect duplicate conveyors from a receiving-hopper on the railway-line to the crusher pit of the inclined retort-house. Erect on a site to be cleared four benches of vertical retorts equipped with coal and coke-handling plant for economical and easy working. This plant will be capable of producing at least 4½ million cubic feet of gas per day.

Coke Plant.—Remove the existing coke-bunkers, and use them for the coke from the existing vertical and inclined retorts. Further storage to be provided for the coke from the existing vertical retorts and the inclined retorts. The telpher conveyor to feed the coke into the bunkers and store the surplus. A new telpher conveyor to be erected for dealing with the coke from the proposed new vertical retorts. This telpher to convey the coke to new receiving bunkers fitted with rotary screens. New storage bunkers to be erected to receive the coke after it has been screened, and arranged to feed it into carts or railway waggons, as desired. The new telpher also to be so arranged that it may deliver the large coke direct into railway waggons or deposit the surplus.

Railway Track.—The existing railway track to be rearranged to allow for underground receiving hoppers, and increased by an additional line to give standage for about twenty waggons. A new double-line railway track to be laid alongside the coke-bunkers for loading. This track will afford siding accommodation for twenty-four waggons.

Coke-Washing Plant.—A washing plant for dealing with coke and pan ash to be erected at a corner of the inclined retort-house. This plant to deliver the graded breeze into either carts or railway waggons. A system of tip-waggons and rails to be arranged to bring the breeze and ash to the washer. Capstans to be installed for moving railway waggons about the yard, also waggon-tippers at each receiving-hopper to empty the coal-waggons.

Condensers.—Remove the existing meters and meter-house, and erect on the site two sets of water-tube condensers—one set capable of dealing with the gas from existing inclined retorts, and one set for dealing with the gas from the proposed new vertical retorts. Both sets of condensers to be connected to a new 30-inch trunk main. The old air-cooled condensers to be dismantled and removed; they being antiquated, and too small.

Exhausters.—The existing exhausters will be too small to deal with the increased make of gas when the new scheme is completed; and will require to be replaced by larger ones—preferably of the turbo type, which will occupy less ground space. Mr. Leech proposes to

arrange the connecting-pipes so as to deliver the gas in two positive streams, using the two end exhausters for this work, and keeping the centre one in reserve in case of breakdown or repairs.

Washing Plant.—The existing scrubber-washer near the locomotive shed to be taken down and re-erected near the exhauster-house, to work in conjunction with the other scrubber-washer of the same type. This will form a washing plant capable of dealing with a maximum of 5 million cubic feet of gas per day. Two new scrubber-washers capable of dealing with a maximum make of 5 million cubic feet per day to be erected on the site near the locomotive shed. Each set of washers to be preceded by one of the tar-extractors now on order.

Purifiers.—New purifiers to be erected in the existing coal-store in the Dewsbury Road yard. This site was chosen in the general outlay of the works as being the most suitable one apart from the fact that carburetted water-gas and the coal-gas purifiers will be brought into the same works, and can be operated by one staff of men, thereby considerably reducing the costs. The purifiers to consist of eight boxes, each 50 feet by 30 feet by 6 feet deep, of the latest type, with luteless covers and connectionless valves. The purifiers to be erected overhead, in order to facilitate emptying, and also to allow the ground floor to be used for revivifying the oxide. An oxide-handling plant to be provided for filling the boxes quickly and cheaply. The existing purifiers at Dewsbury Road to be altered and arranged to act as catch-boxes.

Meters, Trunk Main, and Pumps and Connections.—A new meter-house to be erected near the Dewsbury Road entrance, to include the existing water-gas meter. The large meter at Meadow Lane to be removed and re-erected, and two new meters to be erected. A new trunk main, 30 inches diameter, to connect the condensers, exhausters, scrubbers, &c. New pumps will be necessary for dealing with tar and ammoniacal liquor; and the auxiliary mains to be re-arranged and increased in size to suit the requirements of the proposed scheme.

Cost.—The total cost of the re-construction of the Meadow Lane works as outlined above would be approximately £115,000, and the estimated saving would be at least £21,000 per annum, from which would have to be deducted the interest and redemption fund charges.

York Street Works.

These works are so situated that it is impossible to connect them up to the railway by means of a siding; all coal and coke having to be dealt with by means of carts.

The carbonizing plant consists of one bench of inclined retorts, containing twelve beds of eight retorts, capable of producing 1,400,000 cubic feet of gas per day. There are also two benches each containing fifty direct-fired horizontal retorts (hand charged), having a capacity of 1,200,000 cubic feet per day. This plant is very costly to work in both labour and fuel, and is of little value to the department. The ironwork and firebrick shell of the inclined retorts are in a very poor condition, and will be worn out in the course of a few years. The retorts, however, are being re-set at the present time, as the bench will be required at the end of September.

Leaving out the old horizontal retorts, the total effective capacity of the works is only 1,400,000 cubic feet of gas a day; and as this amount of gas could be easily made by nine men at one of the other works, Mr. Leech recommends that, as soon as sufficient plant is erected and put to work at Meadow Lane, the York Street works be closed as a manufacturing station. The works could either be re-constructed to accommodate the stove and meter department, stores, meter inspectors, &c., or alternatively the site could be offered for sale, and a smaller and more suitable plot purchased for the stove and meter department. In the event of the works being closed for gas manufacture, it would be necessary to arrange a distributing station in this district; and a new trunk main would have to be laid from the Meadow Lane works to supply the gasholders, at an approximate cost of £2400.

Carburetted Water-Gas Plant.

This plant consists of three units each capable of producing 900,000 cubic feet of gas per day, or a total of 2,700,000 cubic feet. The gas-making plant is somewhat out of date. In order to obtain the best results from the fuel and oil used, and to change the method of purification from lime to oxide of iron, thus reducing the cost of manufacture, Mr. Leech proposes to make various alterations and additions to the plant, including the provision of a tar-extractor of special design for the removal of tar-fog before the gas enters the purifiers.

The alterations he details would increase the capacity of the plant from 2,700,000 to 4,500,000 cubic feet of gas per day, and would cost approximately £12,500. The estimated saving is £2889, from which would have to be deducted interest and redemption fund charges.

The Distribution Department.

This department under the Superintendent (Mr. Walter Hole) appears to be well organized, and has been kept up-to-date. The area lighted is 31,621 acres, of which 24,427 acres are within the city, and 7193 acres outside. The total length of the mains is 1003 miles, which is very much above the average for the output of gas. The number of consumers per mile of main is 112. The leakage of gas is given as 7·4 per cent. of the make; but this figure has not hitherto been properly ascertained. The gas used on the works has not been measured; but what would appear to be a generous allowance has been made for this purpose, and deducted from the total unaccounted-for gas, the remainder being taken as leakage. Mr. Leech has had meters fixed in all the works, and hopes by this year-end to arrive at a more definite figure. In addition, the meters will enable him to curtail the enormous amount of gas consumed on the works.

After some remarks on the holder and pumping-stations, Mr. Leech says the distribution department also has charge of the high-pressure lighting system, which is at present being extended. The compressing plant is being removed from the site near the Market Hall to the governor-house in Holmes Street. Two new compressors are being installed, and a new 10-inch main has been laid to the centre of the city. This plant, when completed, will allow for considerable extension of the high-pressure service.

Stove and Meter Department.

This department, so far as stove and meter repairing is concerned, is well managed, and the work is carried on in a businesslike manner. The shops are well equipped, and the work turned out is very satisfactory. The stove and meter fixers, on the other hand, have not been so well looked after; and it is recommended that these men be placed under the control of the Superintendent of the Commercial Department, who also has control of the meter inspectors and other of the outside workers. This would mean that the men would be better supervised, and the duplicating of both foremen or inspectors would be avoided.

Laboratory.

The laboratory now situated in the Dewsbury Road yard is totally inadequate for the requirements of the department. At present all new materials for the whole of the Gas Department are purchased on analysis. It will be necessary to increase the staff on account of the extra testing to be done at the works; and additional accommodation will have to be provided. Mr. Leech recommends that the laboratory be moved to the room now occupied by the joiners at the Meadow Lane works, taking in also the adjoining store-room for the coal-testing plant. The estimated cost of the work is £550.

Output and Quality of Gas.

The output of gas during the last five years has been—

	Cubic Feet.	
1909-10	3,042,854,953	
1910-11	2,952,259,311	
1911-12	2,909,175,988	
1912-13	3,071,238,946	
1913-14	2,821,630,242	(Municipal strike year).

The average make of gas per ton of coal carbonized during this period has risen from 10,967 to 11,433 cubic feet. The illuminating power fixed by Act of Parliament is 14 candles, tested by the "Metropolitan" argand burner No. 2. This Mr. Leech considers is ample for present-day requirements; and he suggests the candle power fixed by the City Council—viz., 15 candles—should be altered to 14 candles. The calorific value of the gas now supplied is 500 B.Th.U. net.

The quality of the gas supplied up to March this year was very irregular, and complaints were continually being made by all classes of consumers. A test made in February proved that the gas supplied in the York Street district contained no less than 39 per cent. of inert gases. At York Street there was no apparatus for testing either for illuminating power or calorific value. There was a jet photometer in the exhauster-house; but this had not been in working order for some time. The quality of the gas was regulated by a flat-flame burner. At the Meadow Lane works, the only apparatus was a jet photometer. The New Wortley works were much better equipped; and the gas sent out from these works was of good average quality. Recording calorimeters, with other necessary apparatus, have now been fixed at each of the works; and these have been placed under the control of the Chief Chemist, who reports as to the quality of the gas. In obtaining a better quality, the make of gas per ton of coal carbonized was for a time adversely affected. Since November, 1913, the pressure at which the gas is supplied has been increased from 28-10ths maximum and 15-10ths minimum to 35-10ths maximum and 18-10ths minimum—a course which has met with the approval of a large number of the consumers.

After the strike in December and January last, the output decreased to the extent of 1 to 1½ million cubic feet of gas per day. This loss was chiefly due to consumers changing over to electricity and other methods for light and power during the strike. The department is now reducing this loss by the extra consumption due to the large number of cookers which have been fixed this season.

There is undoubtedly great scope for expansion among all classes of consumers, especially for gas for commercial purposes. This, however, is held back on account of the high price charged—namely, 2s. 2d. per 1000 cubic feet for all purposes except engines, gas for which is charged at the rate of 1s. 11d. Mr. Leech says he has canvassed and interviewed a large number of manufacturers, and finds that gas for commercial purposes, such as furnaces, at 2s. 2d. per 1000 cubic feet has little chance against other fuels, such as oil and coke. Regarding the supply for power purposes, the department are continually losing customers to electricity or suction gas. He is convinced that they could not only regain these, but considerably increase the number of their consumers, if they could offer gas on better terms.

He recommends that gas for power and for furnaces should be charged at the following graduated rates:—

Cubic Feet per Quarter.	Per 1000 Cubic Feet. s.	d.
Under 250,000	1	9
250,000 to 500,000	1	7
500,000 to 1,000,000	1	5
1,000,000 to 2,000,000	1	4

and for each additional 1,000,000 cubic feet or portion thereof a reduction on the total consumption of 1d. per 1000 cubic feet, until a minimum rate of 1s. per 1000 cubic feet is reached. This would mean a temporary loss of income to the department at the rate of £4000 per annum; but the increased demand due to the reduced price would soon turn this loss into a profit.

Regarding the supply for lighting purposes, the department have been for some time threatened with the loss of several of their largest customers, unless some concession is made to them. Mr. Leech recommends the following scale of charges for lighting:—

Cubic Feet per Quarter.	Per 1000 Cubic Feet. s.	d.
Under 500,000	2	2
500,000 to 750,000	2	1
750,000 to 1,000,000	2	0
1,000,000 to 2,000,000	1	11
2,000,000 and upwards	1	10

This would mean a temporary loss of income at the rate of £1700 per annum.

He is also hoping to be able to reduce the rentals for gas-fires and cookers at an early date, and to arrange special terms for water-heaters.

Residuals.

The coke should be carefully prepared to suit the requirements of different consumers; but little or nothing has been done in this direction. In the schemes recommended for New Wortley and Meadow Lane, there is included plant for dealing with the coke and breeze, and preparing it for any market. The department has done little trade in breeze; and this is readily accounted for by the fact that the whole of the pan ash from the producers, amounting to about 12,000 tons per annum, has been given away. This pan ash contains no less than 35 per cent. of good coke and breeze, amounting to over 4200 tons per annum, which can be recovered at little cost. Mr. Leech recommends that on the expiration of the present contracts, the pan ash be dealt with by the department. He also recommends that a Coke Sales Department be established.

Commercial Department.

This department has suffered considerably through the lack of any organized system for pushing the sale of gas. There has been little or no effort made to increase the output by canvassing the public, and demonstrating to them the advantages of gas for domestic and commercial purposes. Mr. Leech recommends the establishment of a Commercial Department, superintended by the Commercial Assistant (Mr. Mitchell), who should control the canvassers, stove and meter fixers, meter inspectors, lady demonstrator, and maintenance men. To ensure effective supervision of the outside staff, the city should be divided into districts. The meter inspectors should be encouraged to push the sale of gas; and he recommends that bonuses be given for orders received. The men would also make inquiries at each visit as to whether the supply of gas and the fittings in use were satisfactory.

Other proposals put forward by Mr. Leech include the opening of branch show-rooms and the provision of additional office accommodation. The costing of the work done by the various tradesmen employed by the department had not been seriously attempted; but a proper method has now been established on the card system, by which a considerable saving is already being effected. A clerk of works will in future superintend the tradesmen engaged on new work or extensive repairs. In the past it has been usual for the heads of several of the departments to indiscriminately order the goods they require, in most cases without ascertaining the price. This work is now being done by an order clerk, who obtains quotations from a number of firms before the order is placed. This system has already resulted in a considerable saving to the department. A proper system of time-keeping has been arranged in all the works.

Coke-Oven Gas.

Mr. Leech has been for some months in touch with a local Colliery Company respecting an offer made by them to supply the department with the surplus gas from their coke-ovens, amounting to over a million cubic feet per day. He has made a number of tests at the colliery, covering a period of three months, and finds that the quality of the gas at present is not sufficiently high in calorific value to be of any use to the department. The Colliery Company, however, are reconstructing one of the benches, and hope to be able to offer a better quality of gas when this is completed.

British Commercial Gas Association.

Mr. Leech strongly recommends the Committee to become subscribers to the British Commercial Gas Association. From inquiries he has made, he finds that the Association have been of considerable service to their members, and in many cases the results have been so satisfactory that the members have voluntarily increased their subscriptions. The Association advertise freely in the local and general Press, and assist their members in many ways to push the sale of gas. Most of the gas undertakings in the United Kingdom are now members.

Mr. W. R. Herring's Report.

Before dealing specifically with the proposals for re-organizing the Meadow Lane works made by Mr. Leech, Mr. Herring, in his report, summarizes the position from the point of view of producing capacity, output, and probable future demands.

The total present producing capacity of the carbonizing plant, he says, is 18,300,000 cubic feet, without allowing any margin for reserve, plant under repair, and for emergencies. In a city such as Leeds, a margin of 15 per cent. is the minimum that should be maintained to cover these contingencies; so that a safe working capacity of the present undertaking is represented by 15,555,000 cubic feet per day. During the past few years, the maximum day's output has been as high as 18,577,000 cubic feet in 1907, and down to 14,685,000 cubic feet in 1913. Stated in another way, the maximum week's manufacture has been as high as 98,827,000 cubic feet in 1909, and down to 91,429,000 cubic feet in 1913. Of the total gross capacity of the plant, amounting to 18,300,000 cubic feet per day, 5,200,000 cubic feet are obtained from plant of an obsolete and inefficient character, which is much more costly to work, and yields results from the material used 25 per cent. inferior to what can be obtained from modern plant. The obsolete plant should at the earliest opportunity be abandoned; and the Engineer's scheme forms part of this objective.

From particulars given of the position of the undertaking in relation to the demands made upon it during past years, it is seen that the maximum daily delivery has fallen considerably since 1907 until 1911, but that it has risen since that date, though the total quantity made has consistently fallen from 1908 to a minimum in 1912, since when a gradual increase has taken place. Up to 1908, there had been a gradual increase in the total quantity of gas sold; and the price was then, and had been for some time previous, 2s. 1d. per 1000 cubic feet. In 1909, the price was raised to 2s. 2d.; and from that date the gas sold began to decrease, and has since continued to fall.

The question naturally arises from these figures as to the future of the undertaking, and the demands likely to be made upon it. The total number of consumers in Leeds, as shown in the records for the year ending 1913, was 112,884, as compared with 113,109 in 1909. The average consumption, taking the year 1913 as being undisturbed by the strike period, was 33,140 cubic feet by the ordinary consumer and 9140 feet by the prepayment consumer, as compared with the towns summarized in the following table:—

—	Ordinary Consumer.	Prepayment Consumer.	Average Consumption per Consumer.
	Cubic Feet.	Cubic Feet.	Cubic Feet.
Leeds	33,140	9,140	22,232
Birmingham . . .	87,330	17,858	50,084
Bradford	23,543	6,785	22,802
Leicester	55,488	19,430	33,156
Manchester . . .	38,375	10,859	28,258

It will be seen that there is a considerable difference in the consumption per consumer of the different classes in various towns; and, to ascertain the cause for this, Mr. Herring prepared another table, giving particulars of the number of stoves and appliances in use in the respective towns. If these figures are taken as representing a broad view of the situation of the respective towns, it will, he says, be seen that the towns which have fostered the use of stoves and other appliances the most have the best average consumption per consumer, and that in towns like Leeds and Bradford, where the numbers of appliances are less, a smaller average consumption per consumer prevails. If it is, therefore, the Committee's intention to foster the further introduction of every kind of stove and appliance for the use of gas in domestic spheres by means of low hiring rates, hire-purchase, &c., and in the case of trade use by means of specially low rates for gas (based on quantity or other variable scales to meet the varying trade conditions), then in his opinion they can anticipate a very largely increased demand for gas. Such an increase would be beneficial to all consumers, and its acquirement is the only means by which the Committee can hope to reduce materially the cost of gas all round, as an increased consumption per consumer is much more profitable than an increased number of consumers, although these should be eagerly sought for.

Meadow Lane Gas-Works.

Proceeding Mr. Herring states that he has carefully studied the Engineer's report and his proposed scheme of reconstruction and enlargement at these works, and has furthermore closely considered the alternative schemes which he prepared, prior to putting forward the one which is the subject of his report; and he is quite satisfied that, in the peculiar circumstances and from the difficulties presented by the Meadow Lane site, the advice is sound and should be followed, and that the result of so doing will be to the advantage of the undertaking so soon as it can be got into daily use. In general effect, it partakes of the nature of the replacement of plant, which through age is obsolete in type and expensive to work (as compared with modern plant), and yields results 25 per cent. inferior from the materials used.

The scheme will also, while increasing the productive capacity of the Meadow Lane works, afford a much-needed improvement in the methods of handling coke, and in the space available to store it.

It seems to him that the department can do much better with the coke sales from a commercial point of view, provided they go to some trouble in preparing it properly for the customers in the district. Leeds must offer a unique field for the use of such a fuel, if only the quality necessary for domestic and trade purposes is forthcoming. The coke at present made is suitable as to quality, but its physical condition does not meet the requirements of all likely consumers, as it will be for the majority much too large. The proper grading or sizing of the coke, and the cleansing of it, is of supreme importance for industrial use; and Mr. Herring is glad to find that the Engineer has put forward a very complete scheme in this respect. He is sure that —if carried out—this will open up new markets at much better prices than have hitherto been realized for this product.

Coal Storage.

After dealing with the different features of the re-organization scheme, Mr. Herring refers to the subject of coal storage. He points out that on the Meadow Lane site provision is made for a covered coal-store in the building now occupied by the horizontal retort benches. This, however, will accommodate only about 7500 tons, or (say) ten days' supply to the re-modelled and extended works. The building on the Dewsbury Road site, in which it is proposed to put the purifiers, though far removed from the carbonizing plant, is at present used as a coal-store, and holds about 7150 tons. There are also other small stocks deposited in various parts of the works.

The question of storing a sufficient quantity of coal to carry over a period of six winter weeks' requirements is one to which he ventures to draw attention. From his observations, there does not appear to be anything like such provision in any of the works; and while the department can doubtless in normal times rely upon regular deliveries, conditions affecting the coal and transport trades may at any time be such as to interfere with deliveries for a more or less lengthened period; and it is now recognized, both in practice and before Parliamentary Committees, that a provision for six winter weeks' consumption is the proper quantity to lay down to meet the contingencies mentioned. It is not necessary to have the whole of this reserve stock in close proximity to the carbonizing plant, as it is unwise to be constantly handling coal from stock. In practice it is found better to put down the reserve stocks which are intended to meet emergency causes only, and let them lie year after year until the emergency arises. It is quite true they will depreciate in value, owing to exposure; but this is much more rapid in the first year or two than in subsequent years. Soft coal is better stored under cover in well-ventilated sheds; but the Corporation have a quantity of hard coal in their neighbourhood—such as cannel—which can be stored in the open for an indefinite period without losing any of its value.

It does not seem feasible to provide for a greater storage than the 7500 tons already mentioned on the Meadow Lane site; but there is a large area on the Dewsbury Road site which will accommodate quite

a large quantity of coal, which can be easily stored and rehandled by means of steam crane and grab.

ESTIMATED EXPENDITURE AND SAVINGS RESULTING THEREFROM.

In concluding his report, Mr. Herring states that he has gone very carefully through the Engineer's estimates and the cost of carrying out the scheme as embodied in his report, and has satisfied himself that he has made sufficient provision for the proper carrying out of the work enumerated. He has also carefully revised the estimates of the economies likely to result from modern plant being put into use.

He observes that credit is only taken for the direct economies that will arise as a consequence of the adoption of special plant; but the scheme as a whole will result in collateral advantages in the cost of running the works which will materially increase the credit balance. Further, no credit has been taken for the enhanced value which will accrue, due to the better preparation of the coke for the market. Sufficient is, however, shown to more than justify the expenditure and to yield a handsome return, such as will not only pay interest and sinking fund charges on the cost of the installation, but offer also prospects of a reduction in the price of gas to the public.

He says he would like to express his appreciation of the very careful and able manner in which the Engineer has devised and put forward his scheme; and there is no doubt in his mind that, when put into use, the undertaking will reap all the benefits which are forecasted in it.

Discussion in the Council.

Alderman PENROSE GREEN (the Chairman of the Gas Committee) moved the adoption of the Gas Committee's minutes, which included the approval of the report and scheme of the General Manager and the recommendation that application be made to the Local Government Board for permission to borrow £114,717 for the re-organization of the Meadow Lane works, and £12,124 for additions to, and improvement of, the carburetted water-gas plant—the period of repayment to be fifteen years. There was also a further recommendation that £20,000 be borrowed for the purchase of gas-stoves. The saving effected by these improvements, he said, would amount in the aggregate to something like £27,148 per annum, or about 20 per cent. To borrow the money necessary on a term of repayment not exceeding fifteen years would mean a charge on the undertaking of £12,160 a year—leaving a net annual saving of about £15,000. It was admitted the standing charges were a very large item; and some of them would have to run for twenty years. But at the end of this time the undertaking would be almost free, and a great reduction could be made in the prices charged. At present interest and sinking-fund charges amounted to rather more than £86,000 per annum. It was interesting to note that the increase in the output of the Gas Department had been for many years something like 5 per cent., with the exception of the year of the strike. The yearly profits which had been applied in relief of the rates had averaged for the last sixteen years £13,247. The re-organization of the works was urgently recommended by the Gas Committtee, as the earning capacity would thereby be greatly increased. For the future it would be necessary to push the sale of gas and persuade consumers to use more in cooking and for commercial purposes.

Mr. LAYCOCK moved that the recommendation be referred back to the Committee for further consideration. He contended that the only large field for the use of gas was in domestic appliances. He suggested that no rent should be charged for the hire of gas-cookers, as in the case of some other large towns. Manchester, Birmingham, and Glasgow had all tried to effect an increase in the consumption of gas, and had met with no more success than Leeds until they began to loan stoves free. In Glasgow, where previously 1000 gas-stoves had been hired-out in the year, this number had grown to 40,000 when they introduced the system of loaning the stoves free; and in Manchester and Glasgow practically every family was now supplied with a gas-stove. If cookers were supplied free of charge in Leeds, he estimated that in three years they would have 60,000 cookers in the city, thus establishing a tremendously increased consumption.

Mr. A. E. MASSER said he was not impressed with the future of gas in Leeds, and suggested that in the matter of laying out further capital on gas plant it was necessary to move very warily. He believed very little in the future of gas, but a great deal in the future of electricity. It would never be possible for gas to be sold at 1s. per 1000 cubic feet; and there was, therefore, a less possibility in the future of gas competing successfully with electricity. In no case during the last five years in which gas as a motive power had been put in competition with electricity had gas won. He did not think the proposed expenditure upon the gas undertaking could be justified, in view of the ever-increasing demand for electricity. In March, 1908, there were 8379 electric installations for power and light in the city; whereas at the present time the number of installations had increased to no less than 31,166. During the same period the use of gas for power purposes had alarmingly decreased.

Alderman RATCLIFFE, in supporting the motion, said that it was absurd to characterize the whole of the Leeds Gas-Works as an antediluvian, dilapidated, and hopeless concern. If the portion that was really obsolete was eliminated, the remainder was in a very good condition at the present time—so good, indeed, that Leeds was manufacturing gas at less cost per 1000 cubic feet, on all charges that were controllable by the management, than any of the model works in the country. It must not be forgotten that £200,000 had been made in profits during the last ten years. In the past the undertaking had been shamefully mishandled by the Corporation; and the plant had been allowed to become obsolete without any proper effort to bring it up to date periodically. But there was no doubt that under the present scheme the result would not only justify the expenditure, but very rapidly pay for it. The proposal was a sound one, and was backed by the best knowledge and experience that could be brought to bear upon the matter. In regard to the preference shown by many consumers for the use of electricity rather than of gas, this was largely accounted for by the fact that the large consumer of electricity obtained very handsome concessions in comparison with the small consumer. As the prices at present stood, the ordinary householder paid 3½d. per unit for the electric light in his house; whereas the large consumer obtained his electricity for power purposes at ¾d. per unit, or relatively one-fifth of the price charged to the small consumer. The story was a very different one, however, with regard to gas, because in the past the price charged for gas for all purposes had been 2s. 2d. per 1000 cubic feet, whether to the large or small consumer; but it was not sufficient. There was a universal growth of the gas industry throughout the whole country, which was to be accounted for by the fact that gas was being put to a great many more uses than ever before, as it was proving itself to be more suitable for many purposes than electricity. The Leeds gas undertaking could yet be made one of the most successful concerns of the kind in the country.

Mr. MULHOLLAND agreed with Mr. Masser that the production of gas had reached its zenith, and its only future potentialities lay in the domestic sphere. As a body having the control of two important monopolies—gas and electricity—the Corporation must range themselves either on one side or the other. It would be folly for the Gas and Electricity Departments to compete with each other in the same field of operations. As lighting developments in the future would belong almost exclusively to the field of electricity, he thought the present proposal was uncalled for.

Alderman BROWN argued that if, by the introduction of modern plant, they could cheapen the price of gas, there would be a very large increase in the consumption. In the Birmingham Art Gallery and in the largest hall in that city electricity had been superseded by gas, because it had been proved to be far more healthy; and similar changes might be expected in other places.

Alderman PENROSE GREEN, in replying, said the question of loaning gas stoves and cookers free had already been under consideration by a Sub-Committee; and if they could see their way clear to make this concession, it would be done.

On the matter being put to the vote, the amendment was lost; and the proposal to reorganize the works was carried.

SALFORD CORPORATION AND THE PRICE OF GAS.

A Proposed Increase.

A proposal of the Salford Gas Committee to increase the price of gas to ordinary consumers from Jan. 1 next by an addition of 4d. per 1000 cubic feet, and that the supply to prepayment meters be reduced from 35 to 31 cubic feet for 1d., came before the Town Council at their meeting last Wednesday.

Alderman PHILLIPS (the Chairman of the Gas Committee) said he and his colleagues had most reluctantly come to the conclusion that the prices must be increased, to meet unavoidable losses on the department. Referring to the financial side, he pointed out that at the end of March last they had a debit of £9293. This was caused by the increased cost of coal (£4804). The prices for residuals had gone down, and the department had thereby lost £12,400. The prospects were that the position would be very much worse this year in regard to residuals; and it was likely that, owing to the great demand for stoves, over £20,000 would be required for purchasing and fixing. On these extra charges there was interest and sinking fund to provide.

Mr. LEES formally seconded a resolution.

Mr. A. WILLIAMSON moved an amendment to postpone the discussion, pending the presentation of a financial statement.

Mr. BESCOBY seconded, and the amendment was agreed to without dissent.

It was subsequently announced that a special report of the Gas Committee would be presented a week hence.

NOTTINGHAM GAS PRICES.

Writing yesterday, our Nottingham Correspondent said: An agitation is being supported here for a reduction in the prices charged for gas; and this in the face of a falling market for residuals. Truth to tell, despite the bounteous profits which have been yielded through adroit management, the cry becomes so incessant as to represent an entire disregard of the "Dr." and "Cr." sides of the account. But in Nottingham, as elsewhere, there are always the wirepullers who are playing to the municipal gallery. The logic of the situation has, however, been recognized by the Gas Committee, who possess a Chairman who is not inclined to walk upon unreliable ground. The Corporation have already made—thanks to a catch vote—a sorry mess of their inchoate scheme for transforming Nottingham into a port. If the parliamentary fight is to be productive of results in accordance with the ideas propounded, it has been admitted that the gas profits may be again laid under contribution. Who is to pay the piper? Nottingham gas consumers, residing within an easy distance of rich coal deposits, are not just in the humour to tolerate further burdens. Their claim has, however, modestly enough, been for a reduction in price; but in the report which was presented at the meeting of the Council to-day, the Committee stated that, having regard to the war, which has seriously depressed trade generally, and so interfered with the market for residuals as to effect a great reduction in the prices obtainable, they do not now feel justified in making the reduction in the price of gas previously decided upon. The Committee's proposition, with which, it is reasonable to assume, nobody with a realization of the financial contingencies involved will disagree, was therefore that the Council should permit the proposed reduction to stand over for six months. It may be recalled that the Committee, in their last annual report, recommended that a reduction of 1d. per 1000 cubic feet should be allowed to all ordinary consumers of gas, and an additional rebate of ½d. in the shilling to all prepayment consumers from the 1st of January next; the rebate thereby involved being equivalent to a reduction of 1¾d. per 1000 cubic feet. Nottingham's present municipal indebtedness suggested that the alleviation of its financial burdens must be sought from other quarters than its gas revenue. The report was, therefore, adopted.

NEW GAS COMPANY SUPERINTENDENT AT DUBLIN.

Appointment of Mr. Henry F. Cotton.

A report of the Public Lighting Committee of Dublin to the Corporation contains a letter from the Superintendent of Public Lighting and City Gas Examiner, Mr. Henry F. Cotton, resigning these positions on his appointment by the Alliance and Dublin Consumers' Gas Company to the position of District Superintendent. "In going over to the Gas Company," said Mr. Cotton, "it is my desire to create a new era of good feeling between the Company and the Corporation, which will be to the interests of both." The Committee expressed their deep regret at Mr. Cotton's decision, and asked him to reconsider the matter on the basis of an increased salary by annual increments up to £450 per annum; but Mr. Cotton notified the Committee that he had decided to accept the position offered by the Gas Company, and his resignation was accordingly accepted. The report states:

"Your Committee think it only right that they should refer to the great improvements which have been made by Mr. Cotton in the street lighting of Dublin. When he was appointed in 1909, the city was lighted by 4426 gas-lamps, together with the electrical arc lamps, and a small number of electrical incandescent lamps. Of the total number of gas-lamps, over 3700 were fitted with flat-flame burners; the remaining 700 being fitted with an old type of upright burner. The total number of gas-lamps at present in Dublin amounts to 4437, of which 2467 have been altered to inverted incandescent gas-lamps, while a new type of upright burner has been fitted in the remainder. The improvement in the street lanterns arranged by Mr. Cotton also reduced the cost of maintenance and the breakage of mantles, besides improving the lighting. In addition to the gas lighting, the electric arc lamps have been increased to 590; and during the past couple of years a considerable number of gas-lamps was converted to incandescent electric lamps, the total number at present being 450—the supervision of the incandescent electric lamps having been placed under Mr. Cotton's charge. With the recent sanction of the Local Government Board to a special loan for the work, this section will progress very rapidly in future. Mr. Cotton also had in hand several new schemes of rearrangement of the lighting, regarding which he had submitted reports to the Committee, dealing with the suspension system of electric lighting in the centre of a number of streets, and the utilization of the tramway poles for electric lighting. During the period of Mr. Cotton's service with the Corporation, very considerable improvements were made in the Offices and Workshop Department in Tara Street, and in the gas and lamp testing laboratory, bringing them thoroughly up-to-date. The Committee also think it right to mention that in the Board of Trade Meter-Testing Department the income derived during the past five years amounted to £1341, after deducting the working expenses. The increase in the income was substantially due to the fact that Mr. Cotton successfully negotiated with the Belfast meter manufacturers, Messrs. Parkinson and W. & B. Cowan, as to the sending of their meters to be tested in Dublin."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The Edinburgh and Leith Gas Commissioners have shown a good spirit, in these troublous times, by applying to the Bank of England for inscribed stock of the new War Loan, to the extent of £20,000 of annuities sinking fund moneys; and the full sum has been allotted to them. Messrs. Mackie, Koth, and Co. have arranged to implement their coke and sulphate contracts referred to in a former "Note." Bailie Lindsay (Leith) has been unanimously reappointed Convener of the Works Committee, and Bailie Lyon of the Finance and Law Committee in place of Treasurer M'Michall, who did not desire reappointment now that he has assumed the treasurership of the Edinburgh Town Council.

Mr. W. Gordon, the Chief Inspector of Meters in Edinburgh, has again prepared his usual careful annual report on his department. That this is an important branch of the city's work is evidenced by the fact that 90,397 meters were examined and tested during the twelve months ending the 15th of May last. Mr. Gordon refers to the arrangements made by the London County Council for testing high-pressure meters under the exact conditions in which they are to be used, and states that, in view of the importance of Edinburgh as a meter-making centre, arrangements have been made by his department to instal the necessary apparatus required to test the new type of meter. He makes very frequent tests of the illuminating power of the gas as delivered at the City Chambers, in the centre of the town. The maximum power shown by his table is 17·55 candles, and the minimum 15·77 candles, or a gross difference of 1·78 candles; while the average for the year works out at 16·79 candles. It is thus seen that there is not a very great variation in the quality of gas sent out. This is an important point when there are so many incandescent burners in use, as change in quality means readjustment of the air and gas supply if full advantage is to be taken of the gas used. It may be mentioned that the statutory standard is only 14 candles; so that the supply is well above this, even at its lowest point.

At the meeting of the Edinburgh and Leith Gas Commissioners on Monday, a letter was submitted from the Secretary of the Edinburgh, Leith, and District Building Trades Committee, enclosing copy of a resolution, expressing the opinion that the probable effect of the present war on the building industry would be that the usual winter unemployment would be intensified. With a view to alleviating the misery necessarily following, the Committee called upon all public bodies, local and national, to take steps whereby any building work which they were contemplating might be immediately proceeded with, in order that the anticipated unemployment and consequent distress might not be allowed to reach an acute stage before the remedy was applied. The matter was remitted to the Works Committee; and the Lord Provost incidentally suggested that they might also take into consideration the clearing away of the old gas-works, because a good many people were of opinion that if the buildings were removed the site might be got rid of.

A report prepared by Mr. G. Baxter, M.Inst.C.E., the Water Engineer to the Dundee Town Council, gives some interesting details as to the depreciation in water-mains as a result of incrustations forming in the pipes. Mr. Baxter tested the two Lintrathen mains with the following results: The first main (1875) is delivering 5,200,000 gallons per day, and the second (1889) 6,337,000 gallons. The combined delivery of the two mains, and consequently the total volume of Lintrathen water available for the city until such time as one or the other of the mains is scraped, is 11,537,000 gallons per day. Mr. Baxter's predecessor reported the delivery or carrying power of the second main when new, and tested by him on March 28, 1889, at 9,900,000 gallons per day. The carrying power of this main has decreased by 35·9 per cent. within a period of twenty-five years.

Important extensions to the water supplies were agreed to at a recent meeting of the Irvine and District Water Board, who supply the towns of Irvine, Kilwinning, Stevenston, and Saltcoats, as well as Nobel's factory at Ardeer.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Dec.* 7.

The position in tar products continues without any particular change. Pitch is somewhat weaker, and 30s. per ton, in bulk, at makers' works, could not be obtained to-day. Shipments of creosote are being made, and this article is in good demand; the price being firm at rather over 4d. per gallon net, in bulk, at makers' works. Carbolic acid and toluol are also in good demand, but there is little offering. Other values are: Benzol, about 1s. to 1s. 2d. per gallon; 90-160 solvent naphtha, about 1s. per gallon, both net and naked; pyridine bases, 8s. 3d. per gallon net, in buyers' drums; 40-45 per cent. anthracene, 2d. per unit net, casks free.

Makers will not accept less than £10 17s. 6d. per ton for prompt, and want a premium for the spring, for 25 per cent. sulphate of ammonia, net and naked at works. The demand is better, and the position firm.

Tar Products in the Provinces.

Dec. 7.

There is practically no alteration in the markets for tar products. There is no fresh inquiry of any importance for benzol, but the price remains the same. Solvent and heavy naphthas are quiet, and there is little or no business doing in either article. A temporary stop is put on toluol owing to the action of the Government. Creosote keeps firm; and good prices are said to have been paid. Crude carbolic is steady, and business is reported in the neighbourhood of 3s. to 3s. 1d.

The average values during the week were: Value of liquid products in one ton of tar, 16s. 6d. to 18s. Benzol, 90 per cent., naked, North, 8½d. to 9d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 6d. to 2s. 8d. Crude naphtha, in bulk, North, 5½d. to 6d. Solvent naphtha, naked, North, 8½d. to 9d. Heavy naphtha, naked, North, 11d. to 1s. Creosote, in bulk, North, 3⅜d. to 3⅞d. Heavy oils, in bulk, 4d. to 4½d. Carbolic acid, casks included, 60 per cent., East and West coasts, 3s. to 3s. 1d. Naphthalene, £4 10s. to £10; salts, 60s. to 65s., bags included. Anthracene, "A" quality, 2d. per unit; "B" nominally ¾d.

Sulphate of Ammonia.

LIVERPOOL, *Dec.* 5.

In the early part of the week the tone of the market became quieter, but towards the close renewed activity was displayed, especially on the part of middlemen, and prices began to harden still further. The nearest values are now £11 1s. 3d. per ton f.o.b. Hull, £11 3s. 9d. per ton f.o.b. Liverpool, and £11 6s. 3d. per ton f.o.b. Leith. In the forward position there has been a fair amount of inquiry from dealers, but not much from direct buyers, and it is reported that £11 7s. 6d. per ton f.o.b. Leith and Liverpool has been paid to producers for January-June delivery.

Nitrate of Soda.

There is no new feature to comment upon in this article, and spot quotations have remained steady at 9s. 6d. per cwt. for ordinary and 10s. for refined quality.

Sulphate of Ammonia.

From another source it is reported that there has been some business in this article during the past week at improved prices. On the other hand, buyers abroad do not feel inclined to pay any increases. In some cases it is thought that the better prices are merely speculative. Outside London, makes are quoted at £10 2s. 6d. to £10 5s.; Hull, £10 17s. 6d. to £10 18s. 9d.; Liverpool, £10 18s. 9d. to £11; Leith, £11 to £11 1s. 3d.; Middlesbrough, £10 18s. 9d. to £11.

Prepayment Meters for the Wealthy.—"Petroleum is getting terribly scarce in Germany," the "Ironmonger" says, "and various municipalities are doing what they can to promote the use of other illuminants. The Municipal Council of Mannheim, with this end in view, have abolished their rule that penny-in-the-slot meters shall only be allowed in houses of which the rent does not exceed 600 marks (£30). Gas-stoves, electric lamps, and other lighting and heating appliances, are to be supplied on the instalment plan, while electric wiring and gas connections are also to be carried out for easy payments.

COAL TRADE REPORT.

Northern Coal Trade.

There is a rather better demand for coal, but stormy weather impeding voyages and high freights keep back exports. Where prompt shipment can be obtained, slightly easier prices for certain kinds of coal may be taken; but generally the values are maintained. In the steam coal trade, the demand is moderate. Best Northumbrians are about 13s. per ton f.o.b.; second-class steams are from 10s. 10½d. to 11s per ton; and steam smalls are in rather fuller inquiry at 7s. 3d. to 9s. 6d. per ton f.o.b., according to the quality. In the gas coal trade home shipments are full, and best Durhams are steady at 12s. 6d. per ton f.o.b. Second-class gas coals are rather firmer at 10s. 10½d. to 11s. per ton; while for "Wear Specials" the market is strong, and 13s. per ton is the f.o.b. quotation. A contract is reported for some 3400 tons of second-class coals monthly over next year, on the basis of 11s. per ton f.o.b. Other contracts do not seem to be readily settled. There are rumours that American coal is being offered at some of the Italian ports; but the record rates of freight make this rather doubtful, even with the low price of some American coals. Coke is steady with inquiries for next year's delivery in the market. Gas coke is now plentiful; and in some cases prices show ease. Good gas coke is from 11s. 3d. to 12s. per ton f.o.b. in the Tyne.

Public Lighting of Torquay.—A report on the public lighting of Torquay was presented to the Town Council last week by Mr. C. Gillard (the Assistant Borough Surveyor). It stated that the work of conversion to the incandescent system had been continued. In the district of the Torquay Gas Company the price paid was 2s. 8d. per 1000 cubic feet, and in that of the St. Mary Church Gas Department 3s. The amount paid was £1243, against £1316 the previous year.

Gas for Nothing.—In the course of a letter on "Waste in Gas Production," in the "Manchester Courier" last Friday, the author of "Oil" said: "Just before the present titanic struggle commenced, Germany was on the point of carrying out experiments to ascertain the maximum amount of bye-products obtainable from a ton of coal; and a Mr. Leonhard contributed £35,000. If this investigation had been successfully carried forward, Germany's industrial supremacy would have been assured. The system, which is patented in this country, makes it possible to obtain 50,000 to 65,000 cubic feet of gas from a ton, in place of 11,000 cubic feet, as now obtained at gas-works. Having a thermal power between 500 and 600 B.Th.U., the heating power from the new gas would swing between 400 and 500 B.Th.U. This is all right considering we are now in the gas-mantle age. This system will produce three gases in one continuous operation—viz, producer, water, and town's gas. The bye-products other than gas would more than cover the cost of raw materials and working expenses. Hence the gas would be had for nothing."

Wigan Corporation Gas Undertaking.

At the last meeting of the Wigan Town Council, Alderman Angus (the Chairman of the Gas Committee) said he proposed to take back a minute of the Committee, in order that the report on the question of mechanical stokers at the gas-works could be again considered. It was stated that a proposal had been made to call in an expert to advise the Committee; Alderman Dickinson pointing out that the expenditure involved was from £10,000 to £15,000. Mr. M'Curdy said the difference between a proposition of his and that of Alderman Dickinson was that the latter wanted the expert to report on the whole of the undertaking, and he (the speaker) suggested that he should be called in solely in connection with the work at present under consideration. The Mayor (Alderman J. T. Grimshaw) said it had been brought to his notice time after time that the gas-works could be considerably improved; and if they intended making these vast alterations, it might be advisable to have a proper statement concerning the whole of the works. Alderman Cheetham thought they should first have a statement from the Gas Engineer with regard to the proposed improvements. The minute was referred back.

New Joint-Stock Companies.—The following new joint-stock companies have been registered: Finsbury Incandescent Company, Limited, with a capital of £3000, in £1 shares, to carry on business as manufacturers of incandescent gas-mantles and other articles in connection with gas lighting. Thorium, Limited, with a capital of £40,000, in £1 shares (20,000 preference), to carry on the business of importers and manufacturers of thorium and other preparations and articles. The first three Directors are to be nominated by Messrs. Howards and Sons, Limited, and the remaining three by the Voelker Lighting Corporation, Limited. Bonecourt Waste Heat Boiler Company, Limited, with a capital of £1000, in £1 shares, to undertake the manufacture of waste-heat boilers and water heaters.

Tavistock District Council and the Gas Company.—Further reference was made at the meeting of the Tavistock District Council last Tuesday to the dispute with the Gas Company respecting the charge made for lighting the streets for six weeks from September last, when the installation of the electric light was not completed. Mr. Barkell (Chairman of the Highways Committee) said there had been a conference between the Committee and the Directors of the Company; and as the result the Company had reduced their demand from £105 to £100. The Committee objected to a charge of £35 for incidentals which was included in the account, and was meant to cover the cost of the use of the burners, meters, &c., for six weeks. Mr. Chilcot said that if the Company had gone on supplying gas under their contract they would have charged nothing for these extras. The general feeling would be that, though they had made a reduction, the Company had charged about the biggest price they could. It was decided to pay the account.

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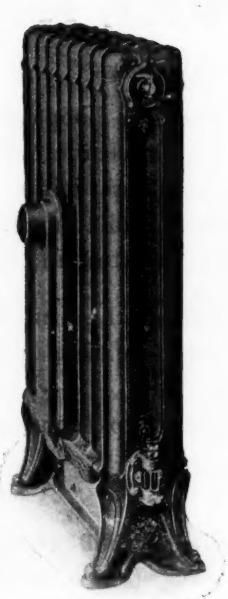

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The Shaded Lamp in Shop Windows.

The following remarks on the above subject appeared under the "Annotations" in the "Lancet" last Saturday: "A word of warning seems just now to be necessary in regard to the shading of incandescent electric lamps in the shop windows. The regulations requiring less light to be employed in the shops are in many instances complied with by simply wrapping round the upper part of the bulb some coloured or darkened paper. This method has its risks, inasmuch as the glowing filament gives off considerable heat; and when this heat is jacketed by an insulating substance, the point of ignition may easily be reached. If an electric lamp be buried in cotton wool, the wool soon commences to scorch, and ultimately to burst into flame. With a free circulation of air round the lamp, there is little danger. There may be seen now in London, however, many very profusely dressed shop windows full of inflammable goods, and in the midst of them all are suspended electric lamps partly wrapped in paper shades. When the windows are heavily dressed with Christmas goods, as they soon will be, the risk will be obviously increased. This is no time for promulgating scares, but we have actual evidence of a paper shade being fired in the way described; and we therefore write seriously on this matter in order that a real risk may be avoided. There seems to be some idea that because an electric filament is enclosed in a glass bulb, and is not flame, it is free from the possibility of setting other things on fire. This is not the case."

Nottingham Gas and Electricity Earnings.—Mr. T. C. Leman, one of the Nottingham Elective Auditors, yesterday presented to the City Council a report in which he directed attention to the fact that the reserves of the gas undertaking represent 50·76 per cent., and the profit for last year 12·54 per cent., of the total capital invested; and he characterized this position as extremely satisfactory. The reserves of the Electricity Department represent 48·38 per cent. of the entire capital outlay, and 79·78 per cent. on the amount employed; the profit being 14·09 per cent.

Province of Buenos Ayres Water-Works Company, Limited.—The Directors, in their annual report, state that the profit for the year ended June 30 last amounts to £30,654, to which has to be added the balance brought forward, giving a total of £36,344. This they recommend should be appropriated in the payment of dividends, making 5 per cent. per annum (free of income-tax) on the preference shares and 6 per cent. per annum on the ordinary "A" shares, in the placing of £5000 to the amortization account and £1000 to the reserve account, and in writing-off expenses of capital issues £4000. This will leave a balance of £5644 to be carried forward. Considerable progress has been made with a scheme of extension; and the increase of the Company's business in the old districts continues. In 1912 there were 8816 services in operation, yielding a gross revenue of £33,951; and in 1914 the number of services had grown to 11,472, and the gross revenue from them to £53,917.

Ammoniacal Liquor for Fire Extinction.

The Merryweather "Hatfield" motor fire-engine at Workington, which was placed in commission a little over a year back, had a somewhat novel experience recently on the occasion of a fire which occurred at the Lowca Coke-Ovens. The Workington Brigade received the summons at 10.15 a.m., and reached the scene of operations (4½ miles away) at 10.30. Four tanks containing about 3000 gallons of naphtha and 2500 gallons of creosote oil were found to be burning fiercely, and were a menace to seven large cylindrical tanks, only 4 feet away, which contained 38,000 gallons of benzol and naphtha. The motor engine, which is of the 400-gallon size, commenced pumping water on to the flames; but subsequently it was decided to use ammoniacal liquor, of which there was a good stock on the works. The change from one supply to the other was quickly made; and with two jets operating the fire was extinguished at 12.10 (noon), before it spread to the large cylindrical tanks. The magnitude of the flames may be realized by the statement of the fact that 60 tons of ammoniacal liquor were pumped by the motor engine before the fire was subdued. Ammoniacal liquor is, of course, an effective fire extinguishing agent; and the Merryweather firm supply a manual fire-engine specially adapted for use with this liquid. But we understand that this is the first occasion on which a motor fire-pump has employed ammoniacal liquor for fire extinguishing purposes.

Longton Gas-Works Assessment.—At the last meeting of the Stoke-on-Trent County Borough Council, the minutes of the Gas Committee were confirmed regarding the question of giving notice of appeal against the assessment of the Longton Gas-Works.

Gas v. Electricity at Newmarket.—Reference has already been made in the "JOURNAL" to the controversy which has been going on at Newmarket between Mr. J. H. Troughton, the Engineer, Manager, and Secretary of the Gas Company, and Mr. F. A. Simpson, the Manager of the Newmarket Electric Light Company, in regard to cost of the illuminants with which they are respectively concerned. As recorded recently [p. 319], gas has triumphed for lighting the workhouse. In one of his letters to the local paper, Mr. Troughton said the *crux* of the controversy was "*£ s. d.*," from the ratepayers' and every point of view; and he submitted the following figures in justification of his contention on behalf of gas: "A unit of electricity contains 3410 British thermal units of heat, and would cost 4d. at the preferential rate offered the Guardians by Mr. Simpson's Company. Therefore, 10½ units of electricity at 4d., 3s. 6d., will produce 35,805 B.Th.U.; 1000 cubic feet of gas at 3s. 6d., 500,000 B.Th.U. A pennyworth of Newmarket electricity will give 852 B.Th.U.; a pennyworth of Newmarket gas will give 11,904 B.Th.U. Gas is therefore 17 times cheaper than electricity for these purposes. This is why electricity cannot compete with gas for heating and cooking, and will not be able to do so until electricity can be supplied at a price approximate to ¼d. per unit."

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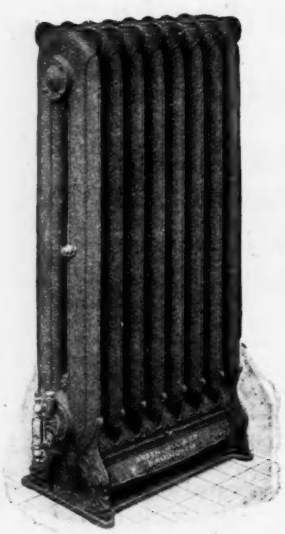

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Novel Gas-Fire Scheme at Nelson.

At the last monthly meeting of the Nelson Town Council, a resolution was submitted by the Gas Committee to the effect that, until the end of March next, dealers in gas-fires be supplied free of charge with the gas required for the purpose of demonstrating the uses of such fires. Alderman Boothman moved that the minute be referred back; remarking that he did not think they were justified in granting a subsidy to private traders for the purpose of increasing their own business. Mr. Winterbottom, in seconding, suggested that the Committee would have acted more wisely had they reduced the price of gas for fires. Mr. C. Townsley (the Chairman of the Gas Committee) pointed out that the main object was the sale of gas. They were not in a position to proceed with the proposed show-room, and in the circumstances he thought the Committee's action was a step in the right direction. As soon as he could see his way clear he would be one of the first to advocate a reduction in the price of gas; but he was afraid this was not likely to be in the near future. The amendment was defeated by one vote.

War Causes Delay at Padiham.—At the monthly meeting of the Padiham District Council, Mr. Russell (the Chairman of the Gas Committee) remarked that, according to agreement, the new retorts ought to have been finished by this time. He had seen the representative of the builders; and a satisfactory explanation had been given regarding the delay. The firm had been placed in the same position as many others owing to the war. They had had a lot of contracts in hand in different parts of the country, but had had to give them up and comply with the demands of the War Office. The delay could not be avoided; but the retorts were being constructed in conformity with the plans of the Council. They would be completed in a short time; and the builders were confident they would give entire satisfaction. It was agreed by the Council that, on the completion of the work, there should be a testing period of twelve months.

Possibilities of Auxiliary House Heating by Gas.—In the course of a paper on this subject read by Mr. W. H. Schofield, of Brooklyn (N.Y.), at the last commercial meeting of the New Jersey State Association, he expressed the opinion that the house-heating problem has greater possibilities than any other in the sale of gaseous fuel. He pointed out that the question is now receiving the serious consideration of some of the largest gas companies, and said that when the same systematic work is done in the introduction and sale of gas heating appliances as is employed in the sale of gas lights and ranges, results of extensive proportion will be realized. In order that the members might contemplate the possibilities, he stated that a prominent manufacturer of high-grade heaters had been requested to quote for 360 gas-heating appliances in an apartment house in New York City. It was estimated that the consumption of gas for heating would amount to 900,000 cubic feet per month, or 5,400,000 cubic feet for six months.

Gas v. Electricity at Bolton.

At the last meeting of the Bolton Town Council, Alderman Haslam referred to a decision of the Electricity Committee to make a quotation to the Darcy Lever Committee for the lighting of Long Lane, and said it was necessary that the Council should go into details of the financial position as affected by the competition between the Electricity and Gas Departments. The Darcy Lever Committee applied to the Gas Committee for terms for lighting Long Lane; but they were evidently not satisfactory. Now they had applied to the Electricity Committee, and terms had been fixed. As far as he could make out, these were much lower than was usually charged for electricity for lighting. One member remarked that the price to be charged for current was the usual figure; while another said there was room for both the Gas and Electricity Departments, but it was a silly thing that one should be allowed to undercut the other—especially when one was required to contribute £20,000 in aid of the rates. Mr. Ritson said the Gas Committee could sell gas at a profit to the town for at least 6d per 1000 cubic feet less than at present; but the Council would not let them do it. Why should not the Electricity Committee be told that they must give money to the rates? Mr. Cooper said the Electricity Committee had subscribed £90,000 in aid of the rates, and hoped to be able to give much larger amounts. The minutes were approved.

Effect of the Reduced Lighting at Wallsend.—On the recommendation of the Roads and Town Improvement Committee, the Wallsend Town Council have decided to pay the Gas Company the sum of £110, being half the estimated loss of revenue for the quarter in respect of the diminution of light owing to the war.

Warrington Gas Committee's Constitution.—The "revolt" of some of the newer members of the Warrington Town Council has had somewhat unexpected results. At the annual meeting, the constitution of one or two committees was drastically altered, exception being taken to the long continuance in office on what are regarded as the important trading committees of some of the older members. As a result of this, Mr. Harry Roberts, J.P., ex-Mayor of the borough, and one of the best known men in the neighbourhood, whose name was removed from the Gas Committee, has now resigned from all the other committees to which he was elected, with the exception of the Education Committee, of which he is Chairman. In the course of his letter to the Town Clerk notifying his resignation, Mr. Roberts says: "The Corporation gas undertaking, owing to the large amount of ratepayers' capital involved, and the volume of business transacted, requires in its management the help of the best commercial brains and experience which the Council possesses. I do not think there is a man in Warrington so dull-witted as to suggest that the Committee has been strengthened in this important particular by the addition of some at least of the individuals who were placed upon it at the meeting."

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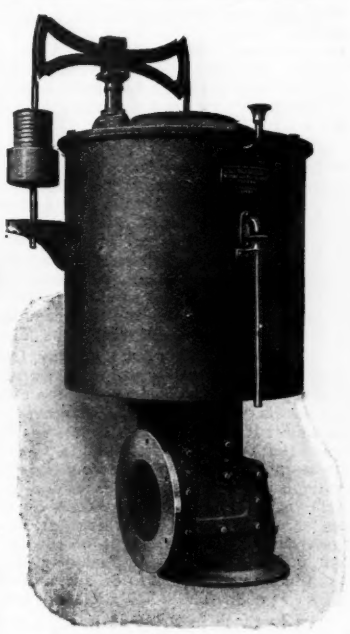

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High-Pressure Gas v. Electricity at Darlington.

At the meeting of the Darlington Town Council last Thursday, it was intimated in the minutes of the Gas Committee that the Engineer and Manager (Mr. Frank P. Tarratt) had reported that he was still receiving applications from prospective consumers for high-pressure gas; and the Committee recommended that he should be authorized to lay additional mains in accordance with the scheme originally submitted. The adoption of the minutes having been moved, Mr. Bates said the Committee were authorized to lay out £1370 on high-pressure gas-mains, and up to the present had only spent £993; and he thought he would be able to prove that it would be unwise to spend the balance. Eighteen months ago the Council discussed the advisability of proceeding with high-pressure gas lighting, or, in the alternative, trying to give an impetus to their electricity undertaking. The latter was, he said, increasing by leaps and bounds. Referring to outside lamps, he quoted figures to show that they could be supplied at greater profit by the Electricity than by the Gas Committee. He confessed to being disappointed at the experiment with gas, which he submitted had been a failure; and he expressed the hope that the Gas Committee would hold their hands until they had made out a better case. Mr. Leng urged the Council to consent to the extension of the gas-mains. He said people had taken electricity because they could not get high-pressure gas. Electric lighting of the streets was not a success; and they were hoping for the time when they would be lighted with high-pressure gas, which had proved a success in Middlesbrough, one of the best-lighted towns in the country. Mr. Pease said he believed they would have to go on laying gas-mains if people wanted gas; and if the Council debated the question for a week they would not get beyond this position. Eventually Mr. Bates moved, as an amendment, to add to the recommendation the words "but before doing so he shall obtain the approval of the General Purposes Committee;" and this was carried by ten votes to seven.

Smethwick Bill to be Dropped.—The Parliamentary Notices in the last number of the "JOURNAL" included one by the Smethwick Corporation for an extension of powers in connection with their gas undertaking. At a special meeting of the Town Council last Wednesday, it was decided not to proceed with the measure.

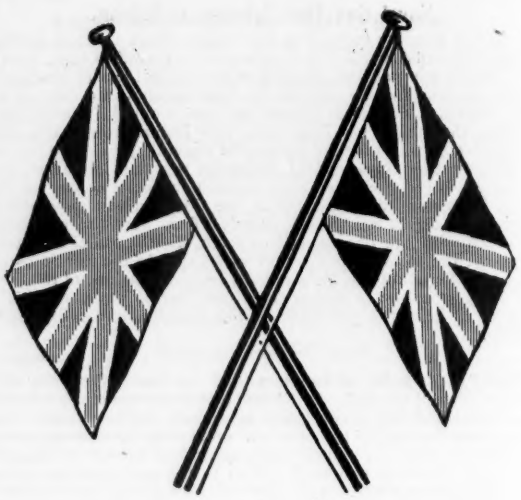
Spent Lime for Sanitary Purposes.—In consequence of the great influx of troops into Falmouth, temporary latrines had to be erected; and the Falmouth Gas Company supplied the local Sanitary Authority with a considerable quantity of spent lime for use where the bucket system was employed. The Gas Engineer and Manager (Mr. H. H. Hoare) has been informed that the spent lime was found to be excellent for the purpose. Absorbent, without the stickiness of earth, it added to the cleanliness of the system. The only complaint was of a "gassy smell" when the lime was supplied fresh from the purifiers.

Lymm Gas Undertaking.—At the last monthly meeting of the Lymm District Council, the District Auditor (Mr. Jordison) reported that for the year ended March 31 the credit balance on the gas-works revenue account amounted to £2322, against £2058 a year before. The cash in the hands of the Treasurer amounted to £222. The Auditor drew attention to the fact that no provision had been made for the payment to the gas-works revenue account for street lighting of £561. The Gas Engineer (Mr. T. H. West) has presented a report on the condition of the works; and a small Committee has been appointed to visit certain undertakings and report on a scheme for remodelling the works.

Fazakerley Gas Supply Criticized.—Complaint was made at a meeting of the West Derby Guardians last week regarding the gas supplied by the Liverpool Corporation from the Fazakerley works. Mr. Welding said that consumers had had to purchase lamps, owing to the inferior quality of the gas. The residents were seriously considering taking out a summons against the Corporation, who they knew had arranged to hand over the works to the Liverpool Gas Company, but had still some time to run. The Clerk (Mr. H. P. Cleaver) remarked that "the gas supplied to the Cottage Homes constituted a danger to the children and staff, and there might be an epidemic of ophthalmia owing to the sulphurous odours."

Continental Union Gas Company, Limited.—The ordinary general meeting of the proprietors of this Company is being held to-day (Tuesday) at the London offices, under the chairmanship of Colonel H. Le Roy-Lewis, C.B., D.S.O. The report of the Directors points out that the audited statement of accounts for the financial year to June 30 shows that the profits amounted to £59 702, to which has to be added the balance brought forward from last year of £6655; making a total available profit of £66,357. Interim dividends of 3½ per cent. on the preference stock and of 2 per cent. on the ordinary stock (both less tax) were paid in July, absorbing £21,658. It is now proposed to pay a final dividend of 3½ per cent. on the preference stock, and of 2 per cent. on the ordinary stock (making 4 per cent. for the year), both less tax, amounting to £21,610 8s. 4d., and to carry over to the next account £23,088. These final dividends will be paid on the 4th prox.

An Increase in Price at Newcastle.—The Newcastle and Gateshead Gas Company give notice that, owing to the exceptional circumstances arising out of the present European war, the Directors have reluctantly found it necessary to temporarily raise the price of gas by 2d. per 1000 cubic feet from the December meter readings. The matter was mentioned at the meeting of the Newcastle City Council last Wednesday, when it was agreed that the Town Clerk should ask the Secretary of the Company what were the "exceptional circumstances" referred to. One member said that the increased price of gas was certainly not because of any rise in the cost of gas coal, which was cheaper now than at the beginning of the war, and it was not on account of any increase in the cost of labour. On the same day, in the Gateshead Town Council, Alderman Penman, alluding to the subject, said that some of the residuals were hardly saleable; and unfortunately the Company would not get any benefit from the fall in coal, they having contracted last summer. The best guarantee he could give the Council that the step was taken reluctantly was that with an increase in price the shareholders received less dividend.



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Dealing in Mantles and Burners at Belfast.

In presenting the minutes of the Gas Committee to the Belfast County Borough Council, Mr. Squire said that the Committee, having learned that four corporations and two companies in the principal cities in England and Scotland traded in incandescent mantles and burners, had resolved: "That, subject to the approval of the Council, the Manager (Mr. J. D. Smith) be instructed to stock and supply to those engaged in the trade, or to gas consumers, incandescent gas mantles and burners, in order that consumers may obtain mantles and burners which will give the best results; and that the Manager be authorized to arrange the charges to be made for same." The Committee proposed to take up this branch of work to enable the citizens to get the very best make of mantles and burners, so that they might obtain full value from the gas. They proposed to have the mantles stamped as a guarantee from the Corporation as to their quality. The Committee proposed to charge the citizens a price 25 per cent. over and above that paid to the manufacturers, and the mantles and burners would be sold wholesale to the retailers at 5 per cent. above the price paid by the Corporation—thus giving to traders 20 per cent. profit. Mr. Longmore moved as an amendment that this paragraph be deleted from the minutes. He did not think it right for the Corporation to enter into competition with the traders of Belfast. The idea that the Corporation could obtain a better mantle than was already on the market, or at a cheaper price, was altogether fallacious. After a prolonged discussion, however, the amendment was defeated, and the minutes were then adopted.

Lostwithiel Public Lighting.—The Chairman of the Lighting Committee of the Lostwithiel Corporation (Mr. Beswarick) stated at the last meeting of the Town Council that the Gas Company had agreed to the principle of paying for gas for the public lighting on the average meter system; the new contract to commence on the 1st prox., and be for three years.

The Hiring of Gas-Fires at Oldham.—At last Wednesday's meeting of the Oldham Gas Committee, Mr. Arthur Andrew (the General Manager) said that at a previous meeting a question was asked as to whether the hiring-out of gas-fires was of advantage to the Corporation. He thought that, at a rough estimate, the revenue would amount to several hundreds of pounds per year. Mr. Griffiths remarked that he would be satisfied if they did not make any profit at all, on account of the benefit to the community in the abatement of black smoke. Mr. Andrew added that gas-fires were being fitted into all classes of houses except the very poor, and they had had a larger demand during the last fortnight than ever. Many people had confessed that they wondered now why they had never used them before.

Fatality at the Dalton-in-Furness Gas-Works.—On the afternoon of the 25th ult., Henry Hartley, a stoker at the Dalton-in-Furness Gas-Works, went to examine the purifiers. He was missed shortly afterwards, and was found unconscious on the floor of the purifier-house. At the inquest, the Jury returned a verdict to the effect that he had been accidentally "gassed;" and they recommended that when a workman was engaged in attending to the purifiers he should have somebody with him. They also suggested the provision of an oxygen bottle at the works.

Nottingham and the Derwent Water Supply.—The unsatisfactory investment of the Nottingham Corporation in relation to its participation jointly with Leicester, Sheffield, and Derby in tapping the head waters of the Derwent is again illustrated by the statement contained in the report of Mr. William Gath, one of the Nottingham City Auditors, which was brought under consideration at yesterday's meeting of the Council. The Water Board's precept for the year shows an increase of £3016; the cheque required in settlement being for £23,727. Mr. Gath, referring to the increase, pointed out that no details of the sum were given.

New Mills Gas Undertaking.—Mr. A. W. Brightmore, an Inspector of the Local Government Board, held an inquiry last week into an application by the New Mills District Council to borrow £7000 for the development of the gas undertaking. It was stated that the amount of loans outstanding on the gas-works in March last was £35,935; and the sum invested for sinking fund was £12,271. The rateable value was £38,438. An amount of £250 was excess spent on the previous application, £500 was for gas services at Disley, and £326 of it had already been spent. The balance was for the construction of a new holder and attendant work. There was no opposition to the scheme.

Chertsey Gas Company.—At the annual meeting of this Company on Monday last week, the amount available for distribution allowed of the payment of dividends at the rates of 12, 9, and 5 per cent., with a balance of £1699 to be carried forward, or only £32 less than last year. The Chairman (Mr. W. Moir) said the Company had passed through the financial year with some anxiety, which was shared by the Directors, and particularly by the managing staff. The primary cause of it had been the coal strike, which had left its disastrous effect upon the previous year's trading, and had necessitated the making of fresh arrangements in regard to the coal supply, inasmuch as the contract became void. This had been very unfortunate two years in succession, cutting the wrong way; but nevertheless the Directors felt that they could with pleasure recommend the usual dividends, and also the dividends on the new share capital recently raised. He trusted they would get through the present year with more success as regarded the coal. The report and accounts were adopted.

GAS COMPANIES IN THE STOCK EXCHANGE.

Another week has passed without revealing that much progress has been made towards the restoration of full business on the Stock Exchange. *Pourparlers* and negotiations are certainly proceeding between the Committee and the Treasury, and modified propositions for a re-opening, hedged round by novel outworks and safeguards, have been under consideration. The upshot is still behind the curtain of the future; but some doubt is entertained as to whether the supreme authority will be won over to give its assent. The minor question as to the admission of members into the building (as a place of shelter only) also remains unanswered. Business last week in the restricted market was more active; dealings in the War Loan forming an appreciable addition to the volume of transactions. The general tone was quite cheerful; and prices in many lines exhibited a move upward. Gas securities were only observable in another place; and on Tuesday Messrs. A. & W. Richards disposed at the Mart of a moderate parcel of Lea Bridge ordinary stock at prices averaging a return of 5¼ per cent. for money. The ease of the Money Market continues unabated.

Bank rate (fixed Aug. 8), 5 per cent.; last year, 5 per cent.

OFFICIAL QUOTATIONS AT THE CLOSE OF THE STOCK EXCHANGE ON JULY 30.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 8	2½	Alliance & Dublin Ord.	59—64	..	3 18 2
374,000	,,	July 10	4	Do. 4 p.c. Deb.	76—79	..	5 1 3
280,000	5	April 29	7½	Bombay, Ltd.	5⅞—6⅜	..	5 17 8
50,030	10	Feb. 26	16	Bourne- 10 p.c.	29—30	..	5 6 8
373,480	10	,,	7	mouth Gas B 7 p.c.	15—15½	..	4 10 4
95,000	10	,,	6	and Water Pref. 6 p.c.	13¾—14	..	4 5 9
380,000	Stk.	Feb. 26	14	Brentford Consolidated	261—266	..	5 5 3
330,000	,,	,,	11	Do. New	204—209	..	5 5 3
50,000	,,	,,	5	Do. 5 p.c. Pref.	109—111	..	4 10 1
206,250	,,	June 11	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
217,380	Stk.	Feb. 26	11	Brighton & Hove Orig.	208—213	..	5 3 4
244,200	,,	,,	8	Do. A Ord. Stk.	154—159	..	5 0 8
530,000	20	Mar. 26	12½	British	44—45	..	5 11 1
120,000	Stk.	June 26	4	Do. 4 p.c. Deb. Stk.	88—90	..	4 8 11
245,771	Stk.	June 26	4	Buenos Ayres 4 p.c. Deb.	85—87	..	4 12 0
100,000	10	—	—	Cape Town & Dis., Ltd.	1¾—2½	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4—6	..	—
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk.	70—75	..	6 0 0
157,150	Stk.	Feb. 26	5	Chester 5 p.c. Ord.	108—110	..	4 10 11
1,513,280	Stk.	Feb. 12	5/9/4	Commercial 4 p.c. Stk.	106—108	..	5 1 2
560,000	,,	,,	5½	Do. 3½ p.c. do.	103—105	..	5 1 6
475,000	,,	June 11	8	Do. 3 p.c. Deb. Stk.	69½—71½	..	4 3 11
800 000	Stk.	,,	4	Continental Union, Ltd.	76—79	..	5 1 3
200 000	,,	,,	7	Do. 7 p.c. Pref.	115—118	..	5 18 8
492,270	Stk.	—	6	Derby Con. Stk.	123—125	..	4 16 0
55,000	,,	—	4	Do. Deb. Stk.	102—104	..	3 16 11
1,002,180	10	July 29	10	European, Ltd.	17½—18*	..	5 11 1
16,392,910	Stk.	Feb. 12	4/17/4	Gas 4 p.c. Ord.	98—102	..	4 15 6
2,600,000	,,	,,	3½	Light 3½ p.c. max.	76—79	..	4 8 7
4,062,235	,,	,,	4	and 4 p.c. Con. Pref.	96—99	..	4 0 10
4,674,850	,,	June 11	3	Coke 3 p.c. Con. Deb.	72½—74½	..	4 0 6
258,740	Stk.	Mar. 12	5	Hastings & St. L. 3½ p.c.	87—89	..	5 12 4
70,000	10	April 29	11	Hongkong & China, Ltd.	16½—16⅝	..	6 11 4
131,000	Stk.	Mar. 12	7½†	Ilford A and C	151—154	..	5 2 4
65,780	,,	,,	6½†	Do. B	115—118	..	5 8 0
65,500	,,	June 26	4	Do. 4 p.c. Deb.	92—94	..	4 5 1
4,940,000	Stk.	May 14	9	Imperial Continental	150—160	..	5 12 6
1,235,000	Stk.	Feb. 12	3½	Do. 3½ p.c. Deb. Red.	84—86	..	4 1 5
200,242	Stk.	Mar. 12	6½	Lea Bridge Ord. 5 p.c.	119—121	..	5 7 5
561,000	Stk.	Feb. 26	10	Liverpool United A	211—213	..	4 13 11
718,100	,,	,,	7	Do. B	146—148	..	4 14 7
806,083	,,	June 26	4	Do. Deb. Stk.	97—99	..	4 0 10

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
75,000	5	June 11	6	Malta & Mediterranean	4⅛—4⅝	..	6 9 9
250,000	100	April 1	4½	Met. of Melbourne 4½ p.c. Deb.	99—101	..	4 9 1
541,920	20	May 28	4	Monte Video, Ltd.	11½—12	..	6 13 4
1,775,892	Stk.	July 29	4½	Newc'tle&G'tesh'd Con.	98½—99½	..	4 10 6
529,705	Stk.	June 26	3½	Do. 3½ p.c. Deb.	82—83	..	4 4 10
55,940	10	Feb. 26	7/14/0	North Middlesex 7 p.c.	14—15	..	5 2 8
300,000	Stk.	May 14	8	Oriental, Ltd.	117—122	..	6 11 2
60,000	5	Mar. 26	10	Ottoman, Ltd.	7½—7⅞	..	6 9 0
60,000	50	Feb. 26	18	Portsea, Island B	128—131	..	4 19 3
100,000	50	,,	12	Do. C	118—121	..	4 19 2
249,980	5	April 29	8	Primitiva Ord.	5⅛—6	..	6 18 4
499,960	5	June 26	5	,, 5 p.c. Pref.	4⅞—5	..	5 0 0
521,600	100	June 2	4	,, 4 p.c. Deb.	91—93	..	4 6 0
346,198	Stk.	June 26	4	River Plate 4 p.c. Deb.	85—87	..	4 12 0
150,000	10	May 14	6	San Paulo 6 p.c. Pref.	10½—11	..	5 9 1
125,000	50	July 1	5	5 p.c. Deb.	47—49	..	5 2 0
135,000	Stk.	Mar. 12	10	Sheffield A	223—224	..	4 9 3
209,984	,,	,,	10	Do. B	222—224	..	4 9 3
523,500	,,	,,	10	Do. C	220—222	..	4 10 1
90,000	10	May 28	9	South African	10½—11½	..	7 16 6
6,429,895	Stk.	Feb. 12	5/9/4	South Met., 4 p.c. Ord.	111—113	..	4 16 8
1,895,445	,,	July 10	3	Do. 3 p.c. Deb.	72½—74½	..	4 0 6
209,820	Stk.	Feb. 26	8½	South Shields Con. Stk.	157—159	..	5 6 11
952,795	Stk.	Feb. 26	6	S'th Suburb'n Ord. 5 p.c.	114—116	..	5 3 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	110—112	..	4 9 3
137,058	,,	June 26	5	Do. 5 p.c. Deb. Stk.	116—118	..	4 4 9
629,740	Stk.	May 14	5	Southampton Ord.	99—102	..	4 18 0
120,000	Stk.	Feb. 12	7½†	Tottenham A 5 p.c.	135—138	..	5 8 8
742,275	,,	,,	6†	District B 3½ p.c.	115—117	..	5 2 7
181,255	,,	June 26	4	4 p.c. Deb.	87—89	..	4 9 11
182,380	10	Dec. 30	5	Tuscan, Ltd.	5—6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	93—95	..	5 5 3
236,476	Stk.	Mar. 12	5	Tynemouth, 5 p.c. max.	108½—109½	..	4 11 4
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	Feb. 26	8⅜	Wandsworth A 5 p.c.	151—156	..	5 7 4
255,636	,,	,,	6⅞	,, B 3½ p.c.	129—134	..	5 3 7
108,075	,,	,,	5/17/3	,, C 3½ p.c.	110—115	..	5 2 0
352,000	,,	,,	6½	Wimbledon 5 p.c.	117—122	..	5 0 5
98,000	,,	,,	6⅜	Epsom 5 p.c.	121—126	..	5 5 2
88,416	,,	June 26	3	3 p.c. Deb. Stk.	66—69	..	4 6 11

Prices marked * are "Ex Div." † Next Dividend will be at this rate.

Belfast Gas Explosion.—In connection with the recent gas explosion [*ante*, p. 382] in a house in Upton Street, Belfast, whereby a girl named Edith Bruce lost her life, Edward M'Grath, who was alleged to have been in the house and to have tampered with the gas-fittings, was subsequently charged at the Police Court with the manslaughter of the girl. The Resident Magistrate, however, refused information, and discharged him; holding that the evidence was purely circumstantial. He said if additional evidence were forthcoming at a later stage, the Crown could initiate fresh proceedings.

The National Coal Mine Proposition.—After considerable discussion, and when a number of councillors had left, the Wigan County Borough Council, at a meeting last Wednesday, passed the following resolution: "That this Council, finding that competition in the price of coal has practically ceased to exist owing to the formation of a ring among the contractors, and the ratepayers having consequently suffered from unduly high prices for this indispensable commodity, calls upon the Government to take steps for the acquisition of national coal mines, in order that the municipalities and other public bodies may be supplied at cost price, and may no longer be placed at the disadvantage of having to buy from an anti-social monopoly.

Liverpool Corporation's Fazakerley Undertaking.—Among the notices of the Provisional Order applications in the last number of the "JOURNAL" was one by the Liverpool Gas Company, for authority to acquire the Fazakerley gas undertaking of the Corporation. It appears, from figures lately issued from the City Treasurer's office, that this has been an unprofitable concern. The cost per 1000 cubic feet last year worked out to 3s. 8·17d., and for the first ten months of the present year to 3s. 10·73d.; the income from residuals being 8·5d. for the latter and 10·13d. for the former period. There was a net increase of 4·22d. per 1000 cubic feet. As the selling price of gas is fixed at 2s. 6d., the loss exceeds 1s. 2d. per 1000 cubic feet. The greater loss is attributed to the advance in the price of coal.

It was reported last week that the London County Council have sold, for £93, 107 lbs. of mantle ash collected from their schools.

At the last monthly meeting of the Stone (Staffs.) District Council, a resolution was passed authorizing application being made to the Local Government Board for sanction to borrow £3764 for works in connection with the local water supply.

The Oldbury Urban District Council have approved of plans for the re-arrangement of the offices at the gas-works, at an estimated cost of £300. The scheme will include better accommodation for the Manager and staff, a room for Committee meetings, a store-room, and a show-room in which gas-fittings and stoves will be on view.

One of the earliest effects of the war was the postponement of the amalgamation scheme of the 26 great trade unions and their 500,000 members. At a recent meeting of the Executives, it was decided to approach the various labour combinations with a view to ascertaining whether immediate action should not now be taken in the direction of consolidation.

The Rochdale Corporation Gas Committee, at their monthly meeting last week, granted an application made by the National Union of Gas-Workers for an advance of 1s. per week on the wages of the lamp cleaners, bringing their remuneration up to 27s. per week. At the same meeting (without any application being made), the Committee awarded 1s. per week extra to part-time lamplighters; and these men now receive 14s. per week.

On p. 496 of the last issue of the "JOURNAL," there was a paragraph under the heading "Newcastle (Staffs.) Gas Department and the Renewal of Mains." This was a mistake on the part of the correspondent who forwarded it. The information contained in the paragraph does not refer to the undertaking of the Newcastle Corporation at all, but relates to the gas-works of the Audley Urban District Council, some four miles distance from Newcastle.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

RESIDENT ENGINEER. Bradford Water-Works. Applications by Dec. 15.
WORKS SUPERINTENDENT. No. 5961. Applications by Dec. 15.
DRAUGHTSMAN. R. & J. Dempster, Limited, Manchester.
RENTAL COLLECTOR. Aldershot Gas, Water, and District Lighting Company. Applications by Dec. 11.
SALESMAN (Control of London Show-Room). No. 5960.
SALES SUPERINTENDENT (Gas and Electricity). Aldershot Gas, Water, and District Lighting Company.
ADVERTISING MAN. No. 5959.

Appointments, &c., Vacant (*continued*).

LABORATORY ASSISTANT. Parkinson and W. & B. Cowan, Birmingham.
ACCOUNTANT'S CLERK. Auditor, care of Streets, Cornhill, E.C.
WORKING FOREMAN (Silloth). Applications by Dec. 15 to Mr. Herbert Lees, Hexham.
ELECTRICIAN-FITTER. Weymouth Gas Company. Applications by Dec. 12.
FITTER. Builth Wells Gas-Works.

Gas-Works Wanted.

Particulars to "PRINCIPAL," Scripps's Advertising Offices, 13, South Molton Street.

Plant, &c. (Second-Hand), for Sale.

TYPEWRITERS. White, Northampton.

Sales of Stocks and Shares.

KINGSTON GAS COMPANY. Sun Hotel, Kingston. Dec. 10.
SHREWSBURY GAS LIGHT COMPANY (Mortgage Bonds).

TENDER FOR Tar.

SHOTLEY BRIDGE AND CONSETT GAS COMPANY. Tenders by Dec. 9.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

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